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The World's Leading Municipal Publication.

SCHOOL GARDEN, *Oakland, Cal.*

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The business man who does not annually charge off depreciation on his mechanical equipment ultimately finds it necessary to go deep into his profits to put his plant in efficient running order. The man who fails to keep himself informed on the up-to-date developments in his field finally has to charge to his personal-depreciation account a sum difficult to estimate. MUNICIPAL ENGINEERING *keeps those interested in municipal improvement affairs alive to all that is valuable and eliminates personal depreciation.*

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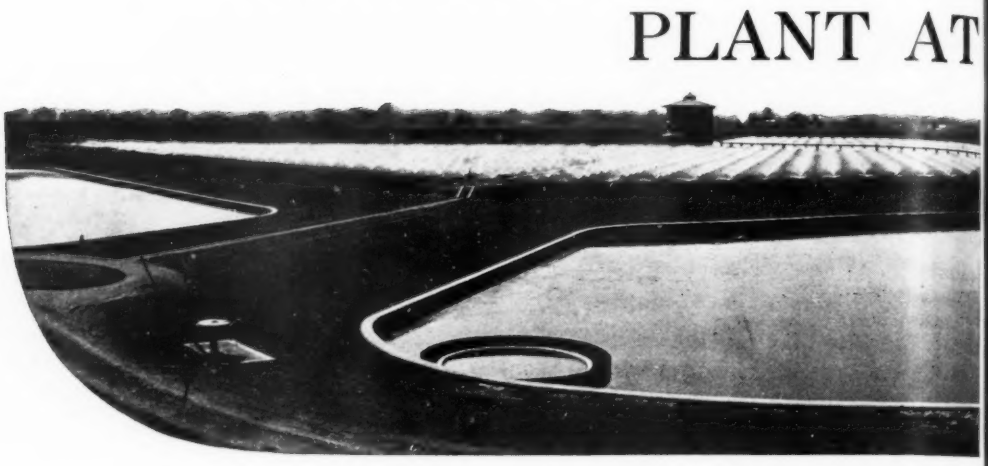


PANORAMIC VIEW OF SEWAGE PU

The sewage flows from the tower thru pipes and is sprinkled on the filter beds, the sprinklers being seen in full action. The effluent from the filters flows back to the tower and thence to the final sedimentation basins seen in the foreground, thence thru the manhole on the left into the Scioto river.

AT the time the sewage purification plant at Columbus, Ohio, was completed MUNICIPAL ENGINEERING published an article, vol. xxxv, p. 211, giving a full description of the process and the plant installed to carry it out. After several years of operation it will be of interest to note the successes and failures in the operation of the plant and the suggestions of improvements, made by C. B. Hoover, the chemist in charge of the sewage purification works, in his report for 1912.

He says that "today the opinion seems to prevail that the difficulties of successfully treating sewage decrease with the rapidity of its collection. At Columbus the length of the sewers, the flat grades, the presence of grit dams and consequent septic pools, and pumping, all combine to increase the difficulties of treatment. Large quantities of grit are washed into the sewers where the combined system of sewerage is in use, and this grit has been a source of trouble at both the pumping stations and purification works."

Collection of Sewage.

It is necessary to collect the sewage from the combined system by interceptors and to pump it to the purification plant. The east side pumping station, on Main street near Alum creek lifts the sewage from a comparatively small district 58 feet over the divide into the main system, and the main sewage pumping station on the west bank of the Scioto river a short distance below Strimmel road, elevates all the sewage of the city an average of 18 feet thru a 48-inch cast-iron force main into the septic tanks, 1.2 miles down stream. The sewage can be discharged into the river unpurified when it is in flood and so the main pumping station can be used at such times to lift storm water into the high river from the low district west. The cost of pumping at the east side station, using natural gas for fuel, was $2.734 to $3.240 per million gallons pumped and that at the main station, using coal for fuel, $1.114. The former is the cheaper when difference in lift is considered.

The removal of sand from the sewage before pumping has always been a serious practical difficulty. Sand catchers are in use and sand cleaning apparatus is being installed.

SEWAGE DISPOSAL AT COLUMBUS, O.

PURIFICATION WORKS AT COLUMBUS, O.

Sedimentation tanks are at the right in the background. At the right of the stairway on the extreme right are the primary sedimentation tanks. At the left of the stairway are the secondary tanks, the discharge from which flows to the tower on the left-hand page.

Escape of Sewage

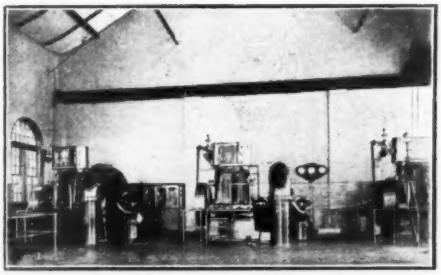
The capacity of the pumps in the main station is 10,000,000 gallons a day. The sewage of the city is estimated to be about 15,000,000 gallons a day, of which 2 1/3 million gallons reach the river directly at the 25 points where the sewage is intercepted from the sewers discharging storm water into the river. This wastage of sewage directly into the river is due to clogging of the intercepters and their connections with the sewers. The amount actually reaching the pumping station is still greater than the capacity of the pumps. In all something like 5,000,000 gallons of sewage reaches the river unpurified, or one-third of the total amount.

This is something more than one-half the amount which produced the nuisance that caused the construction of the purification plant. It is evident, therefore, that there is some nuisance now created in the river at low water stages in hot weather, for which the disposal plant is not responsible.

Purpose of Sewage Treatment

The purpose of the treatment of the sewage is to prevent the gross pollution of the Scioto river below the city, and the evidence of such pollution consists in the blackening of the water, the exhaustion of the dissolved atmospheric oxygen beyond certain limits, the presence of floating masses of sewage solids, and the emission of foul odors. The bacterial pollution of the stream is not so important because there are no public water supplies taken from the river below the city. In order to prevent a nuisance-producing degree of pollution in the river it is necessary to remove entirely certain constituents of the sewage and to convert other constituents from an unstable to a stable condition thru chemical and bacterial agencies. The equipment which has been provided for the treatment of the sewage consists of preliminary sedimentation tanks, hand-operated sprinkling filters and final sedimentation basins. The modification of the sewage which is effected by its treatment at the works, and a varying dilution which the river provides, are the two agencies which are relied upon to prevent the production of a

nuisance. At certain times the dilution which the river provides is so great that treatment of the sewage is not necessary at all. At other times, the slight purification which is effected by plain sedimentation is sufficient, and the degree of modification of the sewage which must be effected by the works increases as the dilution decreases, until the critical stage is reached during the "low water - warm weather" season of the year when the small dilution, sluggish flow and warm weather tax the purifying capacity of the works to the limit.



CENTRIFUGAL PUMPS *in main sewage pumping station, Columbus, O., which force all sewage to the sewage treatment works.*

Preliminary Tank Treatment

The purpose of the preliminary tank treatment is to effect a removal of the coarser solids, which results in a partial purification of the sewage and prepares it for the oxidizing process which follows. When the untreated sewage is discharged from the force main into the tanks, the velocity of flow is so greatly reduced that the solids settle to the floors of the tanks and this deposit is known as sludge. The two problems which are involved in the tank treatment are the production of a satisfactory effluent and the disposal of the sludge. During the year 1912 one small and one large tank were kept in service and the average total period of flow, based upon a complete displacement of the liquor, was 4.86 hours. The average period of flow for the small or detritus tank was 1.04 hours with an average velocity of flow of 2.40 feet per minute, and for the large tank, 3.82 hours with an average velocity of 1.14 feet per minute.

As in previous years, it has been found that the efficiency of tank treatment decreases with the length of the time that the tanks are kept in service and that it is necessary to shift the tanks when the stage of intensely active sludge decomposition has been reached. The service record of the tanks for the year 1912 is as given in table at bottom of page.

The works were out of service from June 1 to 20 because of the cleaning of the sand catcher at the main sewage pumping station.

The operation of the works was discontinued after October 24 because of a shortage of funds.

For the year the period required for sewage to flow thru the two tanks averaged 4.86 hours, varying during the 7 months of operation of the tanks from 3.9 hours in June to 5.7 hours in April. The suspended matter removed averaged 55.5 per cent., varying from 49 per cent. in October to 74 per cent. in June. The deficiency in oxygen in the liquid is shown by an average of 26 per cent. reduction in the percentage of oxygen consumed from potassium permanganate, by the passage of the liquid thru the plant, and the same reduction in oxygen consumed as dissolved oxygen.

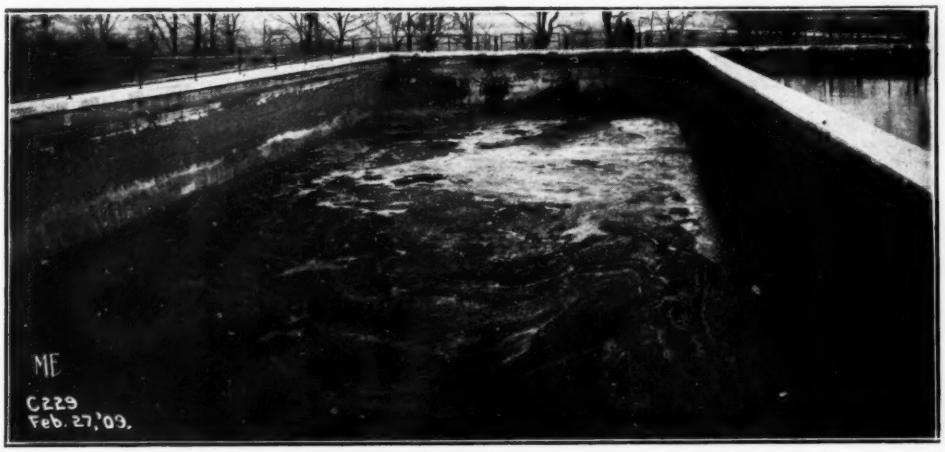
Mr. Hoover states that the present preliminary treatment tanks are not satisfactory and recommends that they be converted into the two-story type, because such tanks will reduce clogging of the nozzles of the sprinkling filters, and the offensive odors, can be cleaned without throwing them out of service, and offer better sludge-disposal facilities. He estimates the cost of the reconstruction at $50,000.

Date in Service.	Tanks in Service.	Total Days in Service.
April 13th to May 28th, inclusive	1 and 5	46
May 29th to May 31st, inclusive	3 and 5	3
June 21st to July 31st, inclusive	1 and 5	41
August 1st to September 5th, inclusive	2 and 6	36
September 6th to October 11th, inclusive	3 and 5	36
October 12th to October 24th, inclusive	4 and 6	13

Tanks Nos. 1, 2, 3 and 4 are the small tanks and Nos. 5 and 6 are the large ones.

Sludge Disposal

Septic tank sludge was flushed to the river on the 17th and 18th of June, at which times No. 1 and No. 5 were cleaned and the river was ten feet above the low water stage. On August 23, tank No. 5 was cleaned by flushing to the gravel pit north of the tanks, and on October 11, tanks No. 4 and No. 6 were cleaned in the same way. The drying of the sludge which was flushed to the gravel pit was effected by evaporation and the percolation of the excess water thru the porous gravelly bed of the pit, but as this bed was not prepared for sludge disposal purposes it only serves as an emergency or temporary device. The sludge has never been removed from the bed of the pit because of the unevenness of the ground, and when the pit becomes filled with ground or surface water during floods, the sludge again becomes waterlogged. Mr. Hoover recommends sludge drying beds of the best type for immediate construction, to be used this summer, at a cost of $25,000.



PRIMARY SEDIMENTATION TANK *of Columbus sewage purification plant, showing the deposits of sludge which must be removed. The sewage inlets are at the farther end.*

Sprinkling Filter Treatment

After the coarser solids of the sewage have been removed by sedimentation in the preliminary treatment tanks, the liquor is ready for the purification process, which consists of an oxidation of the soluble constituents and as a result of which they are converted from an unstable polluting nature to a stable non-polluting condition. The oxidation is effected by chemical and bacterial agencies and the sprinkling filter is simply a device which promotes such activities. The spraying of the tank liquor in the air favors the release of certain offensive gases and also promotes aeration or the absorption of oxygen from the air. The trickling of the liquor thru the 5½ feet of broken stone soon results in the stones (particularly those in the surface foot) being coated with a slime which is found to consist of organic matter, the oxidizing species of bacteria, and many species of microscopic and larger plant and animal organisms. The oxidation and consumption of sewage material is the result of the combined activities of these different agencies and the success of the treatment will be governed by the concentration and character of the applied sewage, the rate of application per unit of area, the uniformity of surface distribution, the size and depth of the filtering material and the temperature of the sewage and air. The temperature of the sewage and air is not under control, and the size and depth of the filtering material are constant factors. During the past year the

SPRINKLING FILTERS *of Columbus sewage purification plant, showing the channels thru which sewage flows under pressure to the upright pipes with sprinkler heads on their tops, the broken stone filling of the filter being dumped in at the left, the semi-cylindrical collectors of the filtrate under the broken stone, which discharge into collecting galleries running to the outlet channel.*

only effort which was made to improve the filter effluent was a reduction of the rate of application by reducing the size of the nozzle orifices.

The sprinkling filters took care of an average of 12,480,000 gallons a day, varying from 11,300,000 in May to 14,840,000 in June. The filter area in service was ten acres, except in April and May it was 8.75 acres. The average time the filters were in operation was ten hours a day; the average volume actually applied to the filters was 1,290,000 gallons per acre per day, and the average rate of filtration was 3,060,000 gallons per acre per day. The suspended matter in the liquid was reduced by the filters 19 per cent. There was a reduction of 61 per cent. in the oxygen consumed from potassium permanganate and of 81 per cent in dissolved oxygen consumed.

But four of the six filter bed units have been constructed and they are just able to take care of the sewage reaching them. If all the sewage reached the purification plant, they could not do the full work required, and new sewers are built each year. Mr. Hoover therefore recommends construction of the other two units at a cost of $120,000. He also recommends installation of an automatic dosing device, which he thinks would increase the efficiency of the filters and reduce the number of men employed, resulting in a saving of $700 to $1,000 a year.

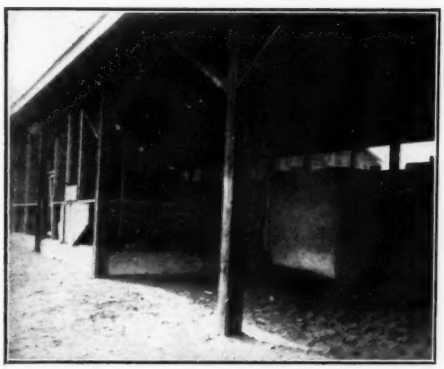
Final Sedimentation

The purpose of the final settling basins is the removal of the coarser suspended matter from the sprinkling filter effluents. It has been the practice at the works to use the final basin only during the late spring, summer and early fall months, or, in other words, during that time of the year when floods in the river are not to be expected. Sludge deposits in the river in the cold weather are not apt to be serious from a nuisance-producing point of view and they are broken up and flushed away by the spring floods before the return of warm weather. During the past year the final settling basins were not in service because of the construction work which was in progress and the total efficiency of the works was somewhat decreased thereby.

When these final settling basins were designed and built it was thought that the

sludge which would be deposited therein would be fairly stable or inert and that consequently they would need to be cleaned rather infrequently. It seemed wise at that time to sacrifice floor slopes in order to get greater capacity and consequently the floors were built with scarcely any slope at all. Later experience showed that the basins would need to be cleaned with greater frequency than was at first expected and the flat floor grades made the cleaning of the basins a tedious and difficult job. The basin which was rebuilt had been used for the storage of sludge from the preliminary treatment tanks when they were cleaned during low river stages and the removal of this sludge was included in the contract as a part of the required excavation. The work consisted of removing all of the old inlet wall and replacing it with a new wall and a new concrete inlet weir; removing all of the old floor and replacing it with a new floor with greater slopes and provided with a branched instead of a single sludge drain; removing the circular outlet weir and replacing it with an outlet weir wall and collector channel along the east retaining wall; relaying about 185 lineal feet of 21-inch vitrified drain pipe; laying about 1,360 lineal feet of 4-inch and 10-inch cast iron pipe, and dressing and seeding certain portions of the slopes around the basin. The inlet and outlet weir walls and the ridge floor in the center of the basin carry the 4-inch city water lines which are provided with 2½-inch hose valves and which are a part of the improved flushing facilities. The 10-inch cast iron pipe is so arranged that the supernatant liquor in the basin may be drawn off thru it at times of sludge removal. The inlet weir wall is provided with sluice gates which may be used for sludge flushing purposes.

The ordinance regulating the keeping of dogs in Memphis provides that a dog must be kept seventy-six hours. To simplify the problem of checking the time a dog is kept, the dog pound is built in four sections, numbered 1, 2, 3 and 4. When received, a dog is placed in section 1, and at intervals of twenty-four hours is transferred to numbers 2, 3 and 4. Section 4 is the death chamber, which is of concrete, 6x6x6 feet with airtight doors. Gas admitted from an 11-inch pipe for a period of 2½ or 3 minutes is sufficient to dispatch a full charge of condemned dogs. The total cost is less than 5 cents. Owners are allowed to redeem their dogs upon payment of $1.00 pound fee and $1.25 license fee.



CONSTRUCTION OF THE GRAND RAPIDS FILTRATION PLANT

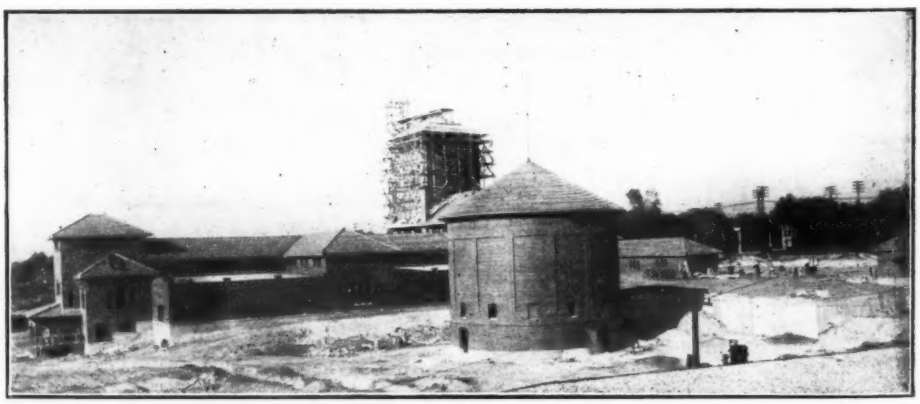
By L. D. Cutcheon, Secretary and General Manager, Board of Public Works, City of Grand Rapids, Mich.

AFTER nearly three years of planning and constructing, the city of Grand Rapids, Mich., has completed a plant for purifying and softening its water supply. Many novel features in the details of the construction, and later in the operation, were found necessary and introduced, and it is believed to be one of the most complete filtration plants now being operated in this country.

The city uses an average of fourteen million gallons per day, supplying nearly 115,000 people with an average of 112 gallons per capita, and has for years drawn its water supply from the Grand river, which forms a division line between the east and west sides of the city. During the past twelve years several investigations and recommendations have been made relative to supplying the city with a water safe for drinking and suitable for laundry purposes. However, no action was taken until three years ago, when Messrs. Hering & Fuller advised the construction of the now completed plant, this being a gravity mechanical filter plant, with a normal capacity of 20,000,000 gallons daily, including provision for softening the water, together with reaction, coagulating and clear-water basins.

Operation of Plant

The general operation of the plant is as follows: Raw water from the river enters the intake chamber about 500 feet from the pumping station, flows by gravity to the low-lift centrifugal pumps, and is then forced to the stilling chamber, that forms a part of the headhouse basement. From here it enters the grit chamber, where heavy suspended matter is settled out. After passing thru the grit chamber it enters the mixing chamber, where chemicals are usually applied, and the water is kept in rapid motion until the proper reactions have taken place. From here it is admitted into the coagulating basins, where most of the impurities are precipitated and the water is prepared for filtration. From coagulating basins it passes into and thru the sand filters, and from them into the clear water basin. From this basin it is led thru a concrete conduit to the high-lift pumping station, 2,700 feet away, being



FILTRATION PLANT, *Grand Rapids, Michigan. Filter buildings and wash water tower under construction.*

sterilized by hypochlorite at the entrance to the conduit, if this should be thought desirable.

Pumping Station

The pumping station is a building 18 by 44 feet, located at the west side of the plant. The main entrance to the plant has been located at this point, and an east view may be considered the face of the buildings.

There are five raw water pumps, two wash water pumps and one sump pump, all centrifugal, single suction, vertical shaft type. These are all located in a pit or basement of the station, whose floor is, during a greater part of the year, below extreme low water. The raw water pumps, being thus located, are always primed. Three of these latter pumps have a capacity of 8,000,000 gallons per day each, and two a capacity of 4,000,000 gallons per day each, all against a 30-foot head. One of the 4,000,000-gallon pumps is so arranged that it can draw water directly from the pump room, and thus acts as a sump pump in case the pit should become flooded. All raw water pumps can be started automatically when the water in the stilling chamber falls below a fixed elevation and stop when it has been raised to another fixed elevation. They may also be controlled by hand. The two wash-water pumps, each with a capacity of 1,000 gallons per minute against a 52-foot head, draw from the clear water basin and discharge into the tank of the wash water tower. This tank is 40 feet 6 inches inside diameter and 11 feet 6 inches deep, containing over 100,000 gallons. The bottom of the tank is about 20 feet higher than the surface of the sand filters. A 20-inch cast iron pipe serves as both discharge from the pumps and outlet to the filters.

Ordinary seepage from the pipe gallery and pump room floors is handled by a small automatic sump pump of 180 gallons per minute capacity.

All pumps are operated by motors located on the ground floor, 17 feet above the basement floor. Alternating current of 2,300 volts is supplied from the municipal pumping and lighting plant a few blocks away. At the filtration plant this pressure is reduced to 440 volts and supplied to the motors.

CLEAR WATER BASIN, *under ground. Grand Rapids, Mich., filtration plant.*

The machinery contract for the pumping plant was let to the Fort Wayne Electric Works. The pumps used are those of the Buffalo Steam Pump Company.

Above the motor room are located the office of the chief chemist and the laboratories. Complete equipment for high-class water analyses has been placed by the city within these laboratories.

Pipe and Operating Galleries

The pipe gallery is 18 feet wide, 125 feet long, and 17 feet high. This extreme width and height makes it possible to maintain a concrete walk through the center of the gallery above the 36-inch raw water force main and the 30-inch drain, and still leave head room below the 42-inch influent pipe, the 20-inch wash water pipe and the 6-inch pressure line, all of which are suspended from the roof of the pipe gallery, which is also the floor of the operating room. All other piping is arranged along both sides and roof of the gallery, and all is readily accessible except the raw water line, which is buried below the floor of the pipe gallery. All filter valves are operated hydraulically at about 65 pounds pressure.

In the operating gallery are filter operating tables of gray Tennessee marble, on each of which are mounted handles and indicating devices for operating the hydraulic valves, a faucet and bowl for sample water, a recording loss-of-head gage, and two gages registering the pressure in the wash water tower and the position of the orifice on the effluent line

to the clear water basin. Two recording gages register the water level in the two compartments of the clear water basin, and are located near the office end of the building. Filter rate controllers of the Earle type are installed, and, in addition to maintaining a constant rate of flow, are constructed in such a way that if the water level in the clear water basin is lowered, the rate of filtration will increase up to a predetermined maximum, when all filters will discharge at this maximum rate until such a time as the water begins to rise in the basin, when the filters will gradually slow down until the basin is full, when they will shut down entirely. The maximum can be set at any desired point between 1,000,000 and 2,500,000 gallons per twenty-four hours.

Filters

There are ten filters, each with a normal capacity of 2,000,000 gallons per day, five on each side of the pipe gallery and operating floor. The filters are supported on the groined circles which form the roof of the clear water basin. Each filter is approximately 25 by 36 feet, outside measurement, and 9 feet deep, and is divided into halves by a center gutter 2 feet wide in the clear. Each contains twelve lateral gutters, six on each side of the center gutter and spaced 6 feet between centers. These gutters, like all the construction, are of reinforced concrete. The lateral gutters are set with their top edges 5 feet 6 inches above the bottom of the filter box, and their bottoms have a slope of 6 inches in the 10 feet 3 inches between the side wall and the center gutter. In washing, all water is carried off thru the lateral gutters, none being allowed to flow directly into the center gutter. The total sand area of each filter is about 734 square feet. It was specified that the sand should have an effective size of not less than .35 nor more than .44 of a millimeter, and a uniformity coefficient of not more than 1.65. The entire bottom of each filter is covered with a system of strainers. These consist of a series of concrete ridge blocks resting upon the floor crosswise of the filter. Each block is 9 inches wide at the base, and there is a space 3 inches wide in the clear between successive blocks, which serves as a water passage. The blocks have vertical sides for 5 inches above the floor, at which point there is a shelf ⅜-inch wide for the support of the strainer plates, above which the blocks continue to a further height of 8 inches in the form of a truncated wedge 2½ inches wide at the top. On the narrow shelf rests a strainer plate, continuous from end to end of the blocks and covering the top of the water passage, or 3-inch space between the blocks. These strainer plates are of bronze, No. 16 B. w. g., with 1/16-inch holes drilled about 1 inch apart over the most of their area. The space above the strainer plate and between the upper portions of the ridge blocks is filled with gravel graded from coarse at the bottom to fine at the top. Resting on top of the gravel and of the ridge blocks, and anchored to the latter, is brass wire screen cloth, No. 20 B. w. g., 10 meshes per inch. Above this screen cloth is placed 2½ feet of filter sand.

In operation the water passes down thru the filter sand, then thru the screen and the gravel, thru the strainer plates to the water passages between the ridge blocks, which passages conduct it to a center collector, thru which it passes into the pipe system underneath the filters. In washing the filters the direction of the flow is reversed, filtered water being passed upward thru the strainer plates, gravel and sand, but at a much higher rate, approximately 2 cubic feet per minute per square foot of sand area. No provision has been made for the use of air in washing.

Stilling Chamber

The stilling chamber in the basement of the headhouse acts merely as a receiving chamber for the raw water pumps and as a center of distribution, the openings into the grit and mixing chamber and double conduits of the center passage being by 36 and 42-inch sluice gates. The grit chamber is 153 feet long and 21 feet wide, divided by a baffle running longitudinally and composed of a 4-inch concrete wall connecting 12-inch square roof piers, spaced 12 feet apart, the end of the baffle coming within 9 feet of the end wall. The capacity is such that when

operating at 20,000,000 gallons a day the water will remain 26½ minutes in the grit chamber. The mixing chamber is 44 feet wide by 160 feet long, and holds about a 53-minute supply at the normal capacity of the plant. The entire chamber is furnished with cross baffles spaced 3 feet apart between centers, constructed of ⅞-inch tongue and groove flooring, stiffened by three 2 by 4 timber braces at intervals of 6 feet, each baffle extending to within 4 feet of the side wall. The water may thus be compelled to take a circuitous course over 2,000 feet in length, but it can be drawn from the mixing chamber into the center passage at four different points, as will be stated later, thus permitting of varying the time for chemical reaction as the condition of the water changes.

Coagulating Basins

The two coagulating basins are each 118 feet 9 inches long, and one is 118 feet 6 inches wide and the other 88 feet 6 inches, the capacities of the two being 1,450,000 gallons and 1,135,000 gallons, respectively. They may be operated singly, in parallel or in series. These basins are provided with "around-the-end" baffles, spaced 15 feet apart and composed of 4-inch concrete walls. The water is withdrawn from each basin over a skimming weir made of stop planks, thus enabling the operator to take the settled water from various depths below the surface. As an aid in clearing the basins, and as a possible temporary raw water supply to the coagulating basins for corrective purposes, a 16-inch cast iron pipe receiving water from the stilling chamber is run to these basins, also to grit and mixing chamber, and provided with 12-inch outlets controlled by gate valves. This will provide raw water for flushing the basins when cleaning them. A 4-inch cast iron pressure main has been laid along the back end of the basins, and 2½-inch hose gates attached provide filtered water for cleaning.

Center Passage

Within the two walls separating the two coagulating basins from the mixing chamber is one of the features of this plant, called the "center passage," consisting of two conduits placed one above the other, the upper one being 10 feet high, 6 feet 4 inches wide at the top and about 5 feet 6 inches at the bottom, the lower one being 4 feet 4 inches high, about 5 feet 6 inches wide at the top and 5 feet at the bottom. Water from the mixing chamber enters the lower conduit thru one of the four sluice gates (depending upon the amount of mixing desired), and from this conduit is discharged into one or both of the coagulating basins. The effluent from the coagulating basins is taken into the upper conduit and by it conveyed to the filters. By-passes with sluice gates are so arranged that water can be taken directly from the headhouse into the mixing chamber, or directly into the coagulating basins, or all the basins can be by-passed and raw water turned directly into the filters. Also, water can be passed directly from the mixing chamber onto the filters or raw water direct to the city mains. In fact, any combination of grit chamber, mixing chamber, coagulating basins and filters can be used by means of this double conduit.

A 12-inch drain pipe is laid under the center passage, from which short branches controlled by sluice gates open into each compartment of the coagulating basins, mixing chamber and grit chamber, the bottoms of which all slope to the sluice gates. This is to provide for removing the sludge and also for emptying the basins. This drain discharges the sludge into the pipe which receives the filter wash water, and which leads into the river several hundred feet below the intake.

From the controllers the filtered water passes directly into the clear water basin, which is divided into two compartments by the pipe gallery. The north basin, occupying the space under the north half of the filters, holds about 384,500 gallons; the south compartment holds about 2,659,500 gallons, and is provided with a baffle wall, which, like most of the other baffles, is a 4-inch concrete wall, extending to within 30 feet of the south wall of the basin, the object of this being to insure circulation of the contained water.

FILTER BUILDING *interior, Grand Rapids, Michigan, water purification plant.*

Chemicals

The chemicals used are lime, alum and hypochlorite. A siding will some day be built from the Grand Trunk Railroad and pass close to the front of the headhouse, so that the chemicals, coal and other materials can be unloaded directly from the cars. In unloading, the chemicals will be spouted into an elevator boot in the basement of a tower which forms a portion of the headhouse. The elevator, an ordinary bucket elevator, will lift them 90 feet to the top of the tower, where they will discharge into a hopper and from there be spouted into concrete storage bins. A small gyratory crusher is provided for crushing lime, and an electric freight elevator for various uses. There are eight storage bins of reinforced concrete, each 8 feet 6 inches square and 19 feet deep, their bottoms being inclined 45 degrees and terminating in cast iron spouts provided with undercut gates. The storage capacity of these bins is about twenty carloads. About ten tons of lime is used daily.

The chemicals are discharged thru the spouts just referred to into circular steel buckets, each holding about 500 pounds, and suspended from ball-bearing trolleys running on a single I-beam overhead track, this track passing under all the bins and over all the mixing apparatus. Each bucket is suspended from a scale with an indicating dial, so that each charge can be weighed.

There are three steel lime solution tanks, each 12 feet 5 inches in diameter by 13 feet 6 inches deep. For slaking the lime, ordinary concrete mixers were adopted, with the idea of overcoming some of the difficulties encountered in stirring large quantities of lime with revolving blades. After slaking, the lime is carried by steel troughs to each of the solution tanks. There are three alum solution tanks of reinforced concrete, and two alum dissolving tanks. On the floor of each of the latter is a pipe grid composed of 1-inch pipes spaced 6 inches apart, perforated on the under side.

There are three covered hypochlorite solution tanks, the center one of which contains a concentrated solution, which solution can be drawn into either of the other two and there diluted to any required strength. The hypochlorite dissolving tank has a false bottom of cast

iron grate bars and spiked shaft placed just above, and so arranged that it may be revolved by hand. The hypochlorite is shoveled directly from the floor to the tank.

For agitating the chemical solutions each of the tanks is equipped with a two-bladed propeller mounted in a vertical funnel-shaped casting, the bottom edge of which is supported 3 inches above the floor of the tank. The propeller is operated by an electric motor. The propeller draws a current of the liquid in thru the top of the funnel-shaped casting and discharges it with considerable force at the bottom across the floor line. The liquid then rises upward along the walls of the tank, across the surface of the tank to the center and down again thru the propeller.

The chemicals flow by gravity from the solution tanks to the feed controllers on the floor beneath, duplicate lines being provided for each solution. Iron pipe is used for the lime and lead pipe for the alum and hypochlorite solutions. It is so arranged that solutions can be applied at different points at short intervals along the center passage and at the entrance to the filters, thus enabling the operator to vary the time allowed for chemical reaction. For each of the solutions duplicate controllers of the Earle type are provided. They are operated in conjunction with a Venturi meter (on the raw water line) and a waste chemical controller, which so regulates the depth of the solution that the head above the discharging orifice varies in direct proportion to the amount of water passing into the reservoirs. Once the orifice has been properly set, the controller automatically proportions the chemicals exactly to the quantity of water passing thru the plant.

In the basement of the headhouse are located the lime-crushing machinery, freight elevator machinery and the steam heating plant, with necessary storage bins for fuel. At the top of the tower are located the bucket elevator machinery and spouting devices.

Buildings

The pump pit, filters and basement of the headhouse are entirely covered with a building, which forms the upper portions of the pumping station, headhouse and wash water tower, and a successful effort was made to make this architecturally pleasing. The exterior walls are of hard-burned, dark red paving brick, all laid in Flemish bond, except that certain portions of the buildings have stretchers of bright colored brick and headers of dark color. All sloping roofs are covered with dark green glazed tile, supported on cinder concrete slabs. For trimming, dark green terra cotta was used. All buildings are lighted by electricity and heated by steam. Practically the entire plant, except the brick facing of the walls of the building, is of concrete, either plain or reinforced. Portland cement, sand with no particles greater than ¼ inch in diameter, and gravel from ¼ inch to 1½ inches in diameter were used in this work. For the greater part of the work these were mixed in the proportion of one volume of cement to six volumes of sand and gravel, the sand and gravel being so graded as to secure a maximum density. Wooden forms were used throughout, except that Blaw forms were used in construction of the conduits.

The roofs of the clear water basins are groined arches, those of the grit and mixing chambers are reinforced flat slabs supported by concrete beams, and the coagulating basins have elliptical groined roofs. The floors of the coagulating basins are inverted parabolic groined arches resting upon a sub-floor of concrete, which is 3 inches thick on firm earth and 6 inches with reinforcement on quicksand. Floors of all other basins are flat, built either of plain or reinforced concrete. In several instances it was considered best to place 6 inches of gravel under the concrete to act as a drain. Steel plates ⅜ inch thick and 12 inches wide were employed in all expansion joints or to join adjacent sections where the structure was too large to be constructed as a monolith. The joints between sections of groined arches were also made in this way. Corrugated and Kahn bars were used for reinforcement, diameters ranging from 3/16 inch to 1 inch being employed. The concrete was

made wet and forms were left in place at least ten days, and generally two to three weeks, especially beneath the arches.

All corners of structures were built in monolithic sections extending at least 6 feet on each side of the corner. The 4-inch baffle walls were reinforced and built in monolithic sections, bonded into columns or walls. All basins, channels and chambers were tested for water tightness, but very few imperfections were found.

Concrete Construction Features

One of the most interesting features of the construction work was the concrete distribution system. The concrete was mixed in a Ransome mixer, which turned out about 125 cubic yards of material a day. The mixer discharged it directly into a bucket which held one batch of 12 cubic feet. This bucket was elevated by cable, attached to the drum of a 125-h.p. steam engine, to the top, or to an intermediate hopper of a tower 157 feet high, this tower carrying a horizontal boom of trussed timber construction. A 7-inch galvanized iron pipe carried the concrete from the top of this tower to a secondary tower, which, in turn, carried two booms, and similar pipes carrying the concrete to the end of each of these booms. At the end of each boom the concrete flowed into another pipe, which was free to move in any direction, its upper end being supported by the end of the boom. This made it possible to reach any part of the plant with the outlet ends of these last mentioned pipes. The concrete was made quite wet, and, after being once discharged from the first bucket, flowed thru the pipes directly into the forms without further handling.

The contractor had a complete plant on the ground for making forms and for other carpenter work required, this including a band saw, rip saw, planer, etc., operated by electric power, together with benches and a complete carpenter's outfit, all inclosed in a substantial frame building.

The construction was divided into four contracts, one for the clear water conduit, intake and drain, which was awarded to J. P. Rusche, of Grand Rapids, Mich., for $51,518.44. The second contract was for furnishing and installing all pumping machinery, and was awarded to the Fort Wayne Electric Works for $12,425, the Buffalo Steam Pump Company furnishing the pumps. The third contract was for the various basins and substructures, including all excavation and grading. This was awarded for $123,842 to A. H. Prange, of Grand Rapids, who, in turn, sublet all concrete work to Gentz Bros., of Grand Rapids. The fourth contract for the construction of the buildings, wash water tower, filters, piping and all the special devices, was awarded for $159,882 to the Roberts Filter Manufacturing Company, of Philadelphia, who sublet all building and concrete work to Gentz Bros. All general plans were prepared by Hering & Fuller, of New York City, Geo. W. Fuller taking charge of the work after the dissolution of this firm. The construction was under the supervision of Samuel A. Freshney, general manager of the board of public works, R. E. Harrison being the resident engineer in charge.

MUNICIPAL STREET RAILWAY SUCCESS

The Finance Committee of the San Francisco Board of Supervisors has the following to say regarding the operation of the Geary Street Municipal Railway, which began operations with the year 1913:

"In four months' operation this railway has paid a handsome profit, notwithstanding that it is burdened with interest charge on $2,000,000 of bonds, only half the proceeds of which are in actual use. It now appears that the road will more than pay its interest and redemption; but, to be on the safe side, the Committee has placed i nthe Budget $20,000 for interest on the bonds of this utility. It is not expected that this $20,000 will be drawn, and it is expected that, before the end of the fiscal year, with the road in full operation from the Ferry to the Beach, municipal operation of street railways in San Francisco will be a demonstrated success."

WHY THE MUNICIPAL OFFICE NEEDS MODERN SYSTEM

By E. H. Gilman, Office Specialist, Rochester, N. Y.

NOWADAYS, when a man walks into the city treasurer's office to pay his taxes, he proceeds immediately to a table over which hangs a sign bearing the number of the ward in which he lives, and gives his street, lot number and name to the man in charge. Without the loss of a moment's time his receipted tax bill is taken from a tray on the table. The money is paid and the transaction closed in two or three minutes.

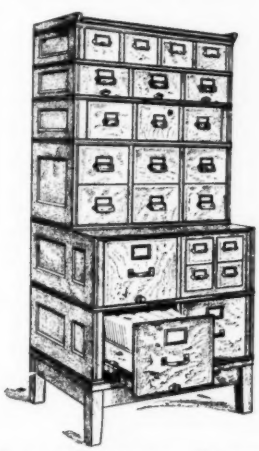
Contrast the quickness and efficiency of this method with the ordinary procedure, whereby a long line of people move patiently up to the desk while huge books are removed from shelves, bills made out and handed out to each one in turn, while the rest wait and listen to the scratching of slow-moving pens.

This is only one instance of the application of modern ideas of filing to city departments. The filing system goes deeper than the mere selection of trays and indexes in which to file the tax bills. If some one had not conceived the idea of making out all tax bills in advance of payment date, the application of the system would have been impossible. The filing system must strike at the root of inefficiency and change methods as well as equipment.

UPRIGHT SECTIONS. *These expand sideways. Each drawer holds 5,000 papers. Great capacity in small floor space.*

Filing Devices in City Offices

The value of filing devices in municipal offices is only exceeded by the value of knowing how to use them to the best advantage. If you are keeping your papers folded up in document files you are availing yourself of a filing method, but it may not be the best method for your purpose. It might save you a lot of time and trouble if you filed your papers flat, instead of folded, and kept them in vertical drawers. To have a filing cabinet is not to have a filing system, and even to have the latter is not a guarantee of filing efficiency. You must have the best system for your purpose.



SECTIONAL FILING CABINETS *adapt themselves to records or papers of any size.*

To illustrate the growing use of vertical drawers in place of document files, we might cite a recent installation of equipment in the new city hall of a town in the Northwest, where, out of a total of ten departments, only two put in any document drawers whatsoever. On the

Cuts are shown by courtesy of Yawman & Erbe Co.

other hand, no less than 143 vertical drawers were installed in nine of the departments.

The advantages of vertical filing for letters and many other kinds of papers are almost too numerous to mention. Papers are placed flat in folders which are filed in deep drawers behind "sign post" guides. All the papers relating to one person or subject are kept in the same folder. Any scheme of indexing can be used—alphabetical, numerical, geographical or subject. Expansion at any point can be taken care of without the slightest difficulty. The drawers moving on frictionless rollers slide open and close at the slightest touch. The capacity of a single vertical drawer is 5,000 papers, and this makes for the greatest economy of space possible in any method.

Assessor

If we pass to the subject of card records, we find that this form of record-keeping is taking the place of book records in all departments of municipal government. Here, for instance, is a card used in the assessor's office. (Exhibit 1.) Each piece of property is recorded on one of these cards, which gives location, owner's name, details of street improvements, and amount of assessment on vacant land, improved property, etc. The card is of a convenient standard size, 6 by 4 inches, and is filed in a cabinet indexed by streets. The file is always kept alive and up-to-date, old cards being removed and new ones inserted whenever necessary. The system is compact, inexpensive and easy to maintain.

Street Department

Exhibit 2 shows a set of cards used by a street department as an index to all records which pertain to their work.

6

AVE. No.

OWNER

STREET IMPROVEMENTS 1911

PAVEMENT SEWER WATER GAS ASSESSMENT

YEAR	VACANT LAND	IMPROVED PROPERTY	PERSONAL PROPERTY	CAUSE OF EXEMPTION	AMOUNT OF EXEMPTION	TOTAL ASSESSMENT
1912						
1913						
1914						
1915						
1916						
1917						
1918						
1919						
1920						
1921						
				"Y AND E" 874923 BM. 3-15		

EXHIBIT 1. *Record cards for assessor's office.*

Each card form is of a distinctive color, making reference easy. If you want to find what work has been done on a certain street you turn to the index guide bearing the name of the street and look over the canary colored forms headed "Work Card." Selecting the proper card, you obtain a reference to the dates and description of work done on this street.

Exhibit 2.

WORK CARD (Canary color)

Street Job

From To

Date Description Book No. Page

STREET NUMBERS (Straw color)
Old No. New No.
Street
Former name
Applicant Date

STREET PLANS (Salmon color)
Street From To
Plan made by No.
Alterations made by
Profile made by No.
Alterations made by
Curb Sidewalk Roadway
Date accepted

SEWER PLANS (White color)
Street From To
Remainder same as "Street Plans" card except one line,
Sewer Book No. Page No.

BUILDING LINES (Dark blue color)
Street
From To
Location Distance Map Adopted

PUBLIC SERVICE (Yellow color)
Street
From To
Name Description Location
Water main
Gas main
House sewer
Storm sewer
Elec. conduit

BENCH MARKS (Red color)
Street
From To
Description Elevation

MANHOLES (Brown color)
Street
From To
Location Description Elevation

STREET SPRINKLING (Light blue color)
Owner
Address
Location of Property Frontage
Book No. Page

Purchases

The card system is also very well adapted for requisition and order systems. The rule must first be made that before you can make a purchase or get any work done, you must make a requisition on the man who has purchasing power and secure from him an order. Requisition forms similar to the one illustrated (Exhibit 3) may be made up in a card index size, 6x5 for instance, and padded in duplicate, alternating paper slips and cards. By using carbon paper you make every requisition in duplicate, sending the original to the commissioner and retaining the copy as your memorandum. The purchasing agent, in this instance the commissioner of public buildings, makes out his order in similar fashion. His duplicate he files in a card drawer behind a guide marked "Unfilled Orders.' When the goods have been delivered or the service rendered, the invoice or claim is O. K.'d, and the copy of the order filed away under the heading of "Filled Orders." You treat your requisition copy in a similar manner. Thus an excellent check is kept on all orders and requisitions.

A very valuable record for the comptroller or purchasing agent is a complete record of purchases, cross-indexed by name of vendor or claimant, and by article. The record may be kept with a minimum of work on two card forms similar to those shown in Exhibit 4, which in full are 8 inches wide by 5 inches high. One card is made out for every claimant who has furnished goods or service to the city. These cards are filed alphabetically and the comptroller can ascertain from them details of all purchases which he has made from any one party. The other card, used as a cross-index, is made out for every kind of article purchased. Spaces for entering the amount of the highest bid and the amount saved by placing the order with the lowest bidder, yield much valuable information to the purchasing agent when he is about to order an additional quantity of this particular article. These cards are filed alphabetically according to name of article, and as time goes on, will become a record of increasing value, enabling the purchasing agent to buy to the very best advantage.

Exhibit 4.

WHITE CARD:
Card No.
Article
Remarks
Column headings are:
Date
Order No.
Purchased from
Quantity
Description
Price Paid
Amount
Total
Highest Bid
Amount Saved

SALMON CARD:

Claimant

Column headings are:
190
B
Claim number
Merchandise
Quantity
Quality
Price
Department
Amount

Water Department

In touching upon the different departments of the municipality in which card records may be used to advantage, we cannot pass by the water department without brief mention of some of the card records which are used in this branch. The value of card records for the water board is especially great in view of the necessity for indexing one record according to location, another according to owner's name, and the third according to meter number, and so on, for adequate indexing is a prime factor in the efficiency of water department records. And indexing reaches its highest point in the card system.

To begin at the beginning, the property owner must first make application for water service, and the service must be installed by the department. In Exhibit 5, three forms are shown; the first, which is an application form bearing the signature of the property owner, being printed on the reverse side of the second card form. Turning the card over, the clerk fills in the heading showing location, name and address of owner, etc., and then copies this information on the other form, which is identical with the one mentioned, except that it bears no application on the reverse, is a trifle longer, and is perforated for a ring binder. This card is turned over to the construction foreman, who carries it in a ring binder to the scene of the work, and after the installation has been made turns it in at the office with full details of cost entered in the spaces provided.

The other card has, meanwhile, been kept in a temporary file. The costs are copied upon this card and thence entered in the ledger. The two cards are then filed away, one according to location, and the other according to name of property owner.

As soon as the service has been installed a permanent record must be made and kept in the water department in a so-called "property record." A card well adapted to this purpose is shown in illustration 6. In the wide space at the top is entered the street and number and owner's name. Below is kept a record of all fixtures installed. These cards are filed according to street and house number and furnish an index to the ledger.

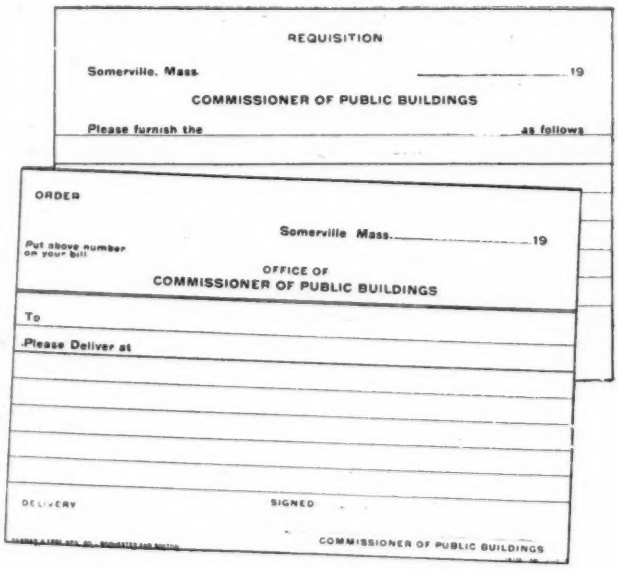
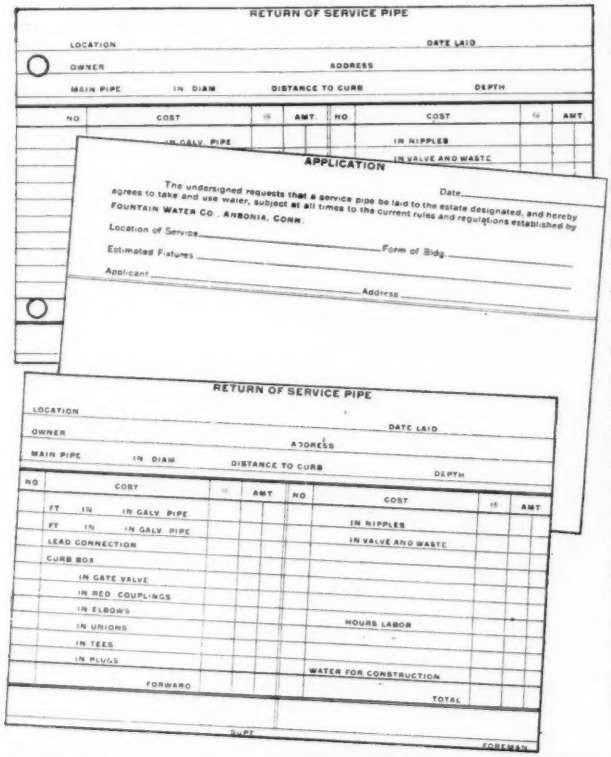


EXHIBIT 3. *Requisition and order cards for purchase of supplies.*

The card ledger is far ahead of any other for the use of the water board. It is generally necessary to use two forms of cards; one for the fixed rate, and the other for the metered houses. In illustration 7 are shown simple forms well adapted for the average department. Both kinds of cards may be filed together,



RETURN OF SERVICE PIPE

LOCATION DATE LAID

OWNER ADDRESS

MAIN PIPE IN DIAM DISTANCE TO CURB DEPTH

NO.	COST	@	AMT.	NO.	COST	@	AMT.
	FT. IN. IN GALV. PIPE				IN NIPPLES		
	FT. IN. IN GALV. PIPE				IN VALVE AND WASTE		
	LEAD CONNECTION						
	CURB BOX						
	IN GATE VALVE						
	IN RED. COUPLINGS						
	IN ELBOWS						
	IN UNIONS				HOURS LABOR		
	IN TEES						
	IN PLUGS						
	FORWARD				WATER FOR CONSTRUCTION		
					TOTAL		

SUPT. FOREMAN

APPLICATION

Date

The undersigned requests that a service pipe be laid to the estate designated, and hereby agrees to take and use water, subject at all times to the current rules and regulations established by FOUNTAIN WATER CO., ANSONIA, CONN.

Location of Service Form of Bldg.

Estimated Fixtures

Applicant Address

RETURN OF SERVICE PIPE

LOCATION DATE LAID

OWNER ADDRESS

MAIN PIPE IN DIAM DISTANCE TO CURB DEPTH

NO.	COST	@	AMT.	NO.	COST	@	AMT.
	FT. IN. IN GALV. PIPE				IN NIPPLES		
	FT. IN. IN GALV. PIPE				IN VALVE AND WASTE		
	LEAD CONNECTION						
	CURB BOX						
	IN GATE VALVE						
	IN RED. COUPLINGS						
	IN ELBOWS						
	IN UNIONS				HOURS LABOR		
	IN TEES						
	IN PLUGS						
	FORWARD				WATER FOR CONSTRUCTION		
					TOTAL		

SUPT. FOREMAN

EXHIBIT 5. *Record of applications for water service, connections and service pipes.*

indexed either numerically or alphabetically. For these cards and also for the property index cards, ledger desks with their capacity for handling thousands of cards in a limited space, are widely used.

The use of cards is also extended to the work of the meter readers. A card per sample 8, perforated for use in a ring binder, is made out for every house in which the service is metered. The cards are kept on file in the office, arranged by routes. Every day the meter readers remove a bunch of the cards from the files and take them with them on their trips, returning them at night.

The use of cards is being extended to all departments of municipal governments. Scores of different uses can be described, but space permits of mention of only a few. From these few, however, some idea may be obtained of the adaptability of card records for a wide range of uses, and some notion may be gained of their time-saving and labor-saving possibilities.

Filing Cases

Another matter that has received a considerable share of attention in municipal offices is the care of valuable maps, drawings, blue prints, and other large sized sheets, which are ordinarily rolled up and stored in pigeon holes, where they accumulate dust, or are kept in clumsy drawers, where it is almost impossible to get at them when they are wanted. In city engineer's offices, in water construction offices, in the offices of street and park commissioners, and many other departments, a large vertical file is now used. This is termed "The Mammoth Vertical File," and a good idea of it may be had from the illustration. Compact as is this file, occupying a floor

OCCUPIED AS STORY

NO.	FIXTURES	LOC.	ASST.	NO.	FIXTURES	ASST.
	Hydrant				Stable - C.W.	
	Sink				Stalls	
	Bath				Vehicles	
	W.C. - Ss.				Screw Bibb	
	W.C. - Nac.					
	Screw Bibb				Stable - No. W.	
	W.B.				Stalls	
	Heat Blr.				Vehicles	
	2r. - 1 fam.				Cattle	
	3r. - 1 fam.					
	4r. - 1 fam.				Garage - C.W.	
					Autos	
	No. C. Water				Garage - No. W.	
	rooms, 1 F.				Autos	
	Cellar Stop					
	Service No.					
	Curb Stop					

EXHIBIT 6. *Record of Fixtures and Services Used by Customer.*

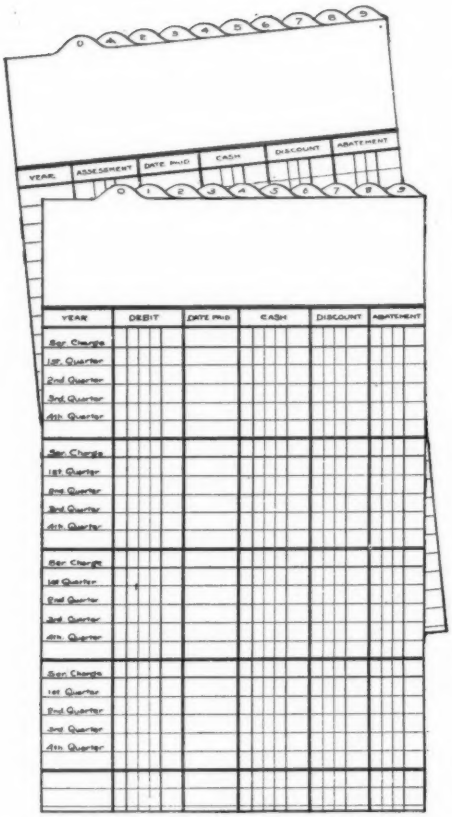


EXHIBIT 7. *Card ledger for accounts of water consumers.*

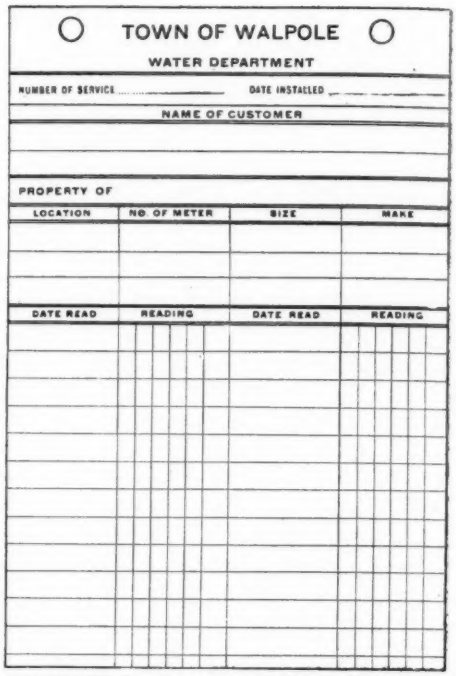


EXHIBIT 8. *Card for taking readings of water meters.*

space of less than four square feet, it nevertheless will take care of from 700 to 1,000 drawings or blue prints. They are kept flat in large pockets and so indexed as to be immediately available. A clever device makes it possible to use the front of the cabinet as a reference table.

Men prominent in municipal affairs are everywhere awakening to the advantages of up-to-date filing and card records, and to the necessity of installing adequate filing equipment. They are among the foremost in the efficiency movement which is sweeping over the country, and it is proper and fitting that we should look to the public offices for an example of modern system ideas.

The author would be glad to communicate with any who desire further or more detailed information regarding any of the records which have been touched upon in the foregoing. Samples of cards in actual use and covering a wide range of requirements will be gladly sent. The exchange of ideas on this subject would be mutually profitable and is a thing to be desired.

TEST OF WATER DIVINING EXPERTS

The English *Sanitary Record and Municipal Engineering*, published in London, recently made a test of the ability of water diviners to locate bodies and streams of water with hazel twigs or other such supposed indicators. Six Englishmen and one German offered themselves for test. The committee of well-known engineers, scientists and municipal officials reported that what little sensitiveness to underground water may exist in some persons is not sufficiently definite and trustworthy to be of much practical value. Known bodies and streams underground were not definitely located if at all and other locations were erroneous.

PASADENA MUNICIPAL LIGHTING PLANT

THERE has been so much controversy recently over the results of the operation of the Pasadena electric light plant, the statements made in the discussions of it have been so imperfect, so incorrect, and so garbled, and the omissions from the statements have been so numerous and so misleading that it seems worth while to gather together the information that has been published by those on both sides of the controversy into a story which will be as consistent as possible with itself and will show as nearly as possible why it differs, where it may, from any statements which may have been made.

Glenn Marston, in his "200 Municipal ownership failures," says the plant had only 1,700 customers as compared with 4,000 of a private company and that the plant charges the city rates for street lighting which are equivalent to $1.16 per capita per year as compared with 65 cents average in California cities. As usual, in the pamphlet referred to, the statements are out-of-date, incorrect, based on wrong assumptions and therefore misleading, apparently with intent, as will be seen from the facts. The plant is not yet six years old and had only 1,700 customers three or four years ago but had 4,333 meters in use on January 1, 1913, with the number increasing every month. Pasadena has many wealthy citizens, occupies a large area and pays more for its exceptionally good lighting in proportion to its population than less favored cities, altho it pays as low a rate per lamp per year as its neighboring cities and pays far less for ornamental lighting.

Before the municipal plant was started the city was served by what is now the Southern California Edison Company, which serves some twenty-five or thirty municipalities with a total population of 450,000 to 475,000, including Los Angeles, 320,000, and Pasadena, 32,000, and several of 10,000 to 18,000 population. It is stated that the company's commercial base rate was formerly 12½ cents per kw. hr., reduced from 15 cents when a municipal plant was threatened. The rates now in force in other cities than Pasadena are from 8 to 10 cents, excepting in Los Angeles, where the rate is 6½ cents. The rate paid the company by the city for arc lamps was $78 a year, moonlight schedule.

Whether the starting of the municipal lighting plant was a political measure or was a real protest against the rates charged and the poor service rendered, can not be definitely determined from a comparison of statements at hand, and really makes no difference in the result. Notwithstanding the power of the city to regulate rates within reasonable limits, the decision to build the plant was made and rates have been reduced.

The city pays the electric light plant $60 a month for arc street lights, moonlight schedule, or 23 per cent. less than it paid the Edison company. This is the same price that the company charges most of the other cities it serves, the $76 charge to Los Angeles for all night service being practically the same in proportion to candle power furnished. There is therefore no basis for Marston's statement that the Pasadena rate is the highest in the state.

Rates Present and Past

The city charges for commercial incandescent lighting, 5 cents per kw. hr. for the first 100 and graduated lower prices down to 3 cents for all over 2,000 per month. Since February 1, the minimum monthly charge has been 60 cents for 3 kw. meters and 30 cents for each additional kw. of meter capacity. Gem or metallized lamps are furnished free if more than 50 watts capacity is in use, and agreement is made that when the number of consumers reaches 6,000 the minimum will be reduced to 50 cents.

Power rates are 4 cents for the first 100 kw. hrs. and graduate down to 1.2 cents for all over 3,000 used in a month. The minimum charge is $1 per month on meters of 1½ capacity and 75 cents for each additional kw. capacity.

These rates are certainly less than the 15 or 12½-cent base rates prevalent under company service six or seven years ago, and less than the reduced 8 to 10-cent rates the company now charges all the smaller cities it serves, and appreciably less than the 6½ to 2.3-cent rates charged in Los Angeles by the same company.

The saving to light and power users in Pasadena is evident.

The municipal plant was constructed first with capacity for street lighting and some commercial lighting in the business district, the first bond issue in 1906 being $125,000. Later general commercial lighting was decided upon and the plant has been enlarged as detailed below, to take care of the rapidly increasing load on account of the growth of the city and of the business of the plant.

The city's plant first charged 9 cents as a base rate as compared with the company's 12½ cents with 10 per cent. discount for cash. The company dropped its rate below that of the city's plant and the city, as its operation of the plant developed the possibility of doing so, has reduced its rates to those given above, the latest reductions being in the minimum rates and granting of free lamp renewals.

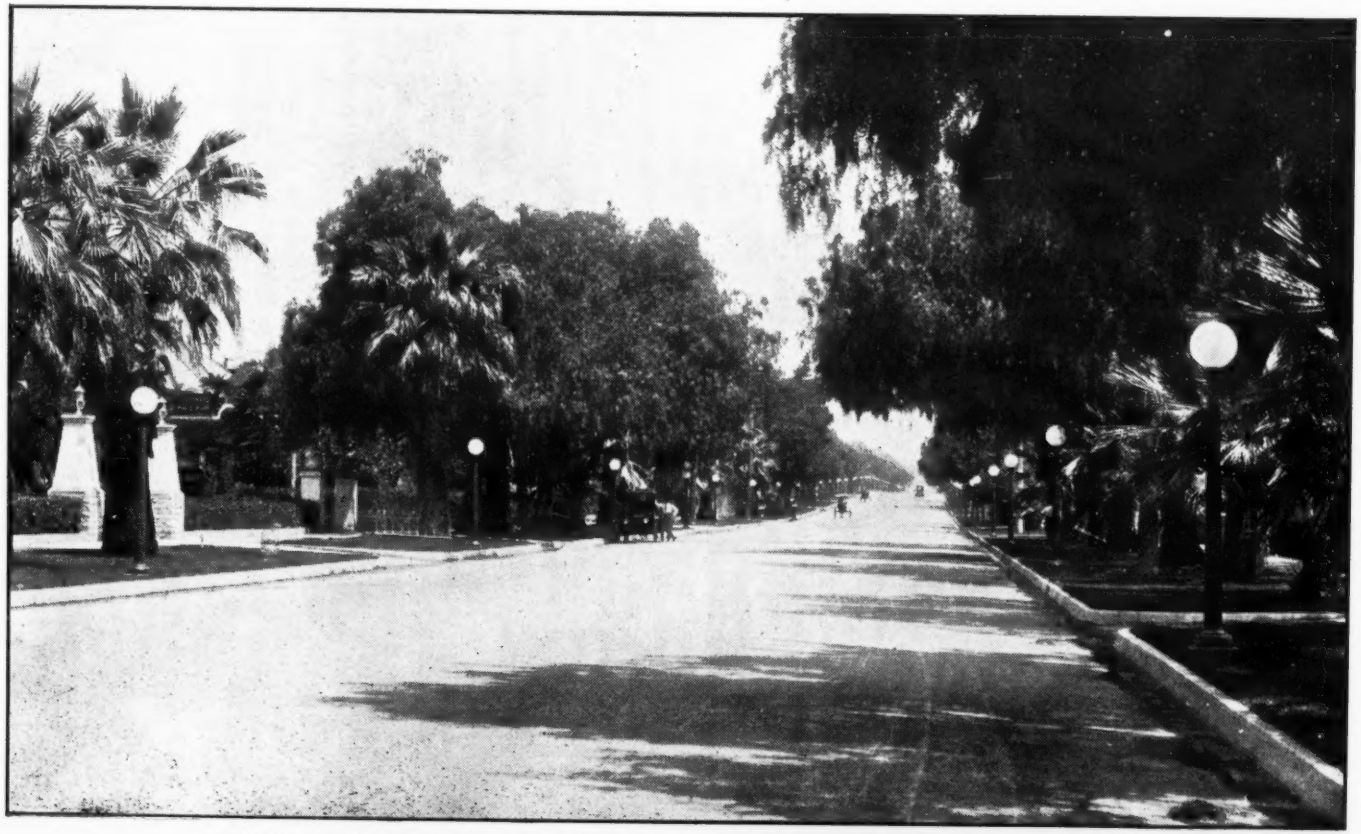
The company has dropped its rate to 4 cents for the first 100 kw. hrs., graduated down to 2¾ cents for all over 2,000 kw. hrs., with free lamp renewals and no minimum. The city does not attempt to meet these rates, believing that it cannot do so without running at a loss, whereas it is now able to make a substantial addition to its surplus each year after paying interest and bonds as they come due and making allowance for depreciation according to a carefully devised schedule for all the various parts of the plant.

Because the city does not meet the company's price the company claims that the city cannot compete with it and induces the inference that the city's plant is losing customers, whereas, it has gained customers every month but one since it began business and gained 6.2 per cent. in the number in the last full fiscal year. The city believes that the company is losing money on its Pasadena business at its present rates and has tried every method except one of forcing an increase. An appeal to the a maximum of 8 cents, which took effect January 1, 1913. The company agreed to reduce rates in cities to 8 cents also. The city pressed this suit in the belief that if the company was obliged to reduce its rates in all the territory it serves under the methods of the State Railroad Commission, it would not have surplus enough from operations in those cities to make up the deficit in its Pasadena business and so would be obliged to raise its rates to a practical equality with those which the city has found reasonable.

Rate Regulation

The city has now taken up the matter with the other cities served by the company, proposing that each one fix the lighting rates by ordinance, as each one has the legal right to do, taking Pasadena's experience as a guide in the investigation to determine what the rates should be. In this way they think the rates would probably be reduced so that the surplus to meet the company's losses in Pasadena would be reduced if not wiped out. The company considered itself justified in making the combinations and extensions which have resulted in its present extended business, but is evidently not pleased when the cities it serves are proposing to make a similar combination. They are easier to handle singly.

Pasadena passed one ordinance which may produce some of the effect desired. This ordinance fixes the rates for electric current for power at 6 cents for the first 100 kw. hrs., graduated down to 1.2 cents for all over 3,000 kw. hrs. used per month, being the same as the Los Angeles rates, with the proviso that if lower rates are charged the plant using them must file certified statements of accounts showing that the plant can make 4 per cent. on its investment at these lower



ORNAMENTAL STREET LIGHTING, *Orange Grove Avenue, Pasadena, California.*

rates. The city plant has complied with this ordinance but the company has not, thus giving some color to the claim that the city's power to regulate rates is theoretical rather than practical, in the absence of the power to supply the service independently of the company.

The company very pertinently asks why, under its established power of rate regulation, the city does not fix the rates at which electric current shall be sold. The city attorney replies in an unofficial communication, substantially that, since such an ordinance would increase the rates now charged by the company, it would give an argument for political use which would be stronger than the city administration is willing to put into the company's hands. The ordinance fixing power rates is such an ordinance as far as it goes, but, since Pasadena has very few power users and they are in general loyal to the municipal plant, it does not influence any very large number of votes.

To the outside observer, an ordinance definitely fixing rates for lighting based, perhaps, on those of Los Angeles, like the power ordinance above described, would seem to be the proper procedure. Unfair misrepresentation could not go farther under such an ordinance than it does at present, altho it would directly touch the pocketbooks of more voters. But the citizens, especially those resident long enough to know the history of the controversy, are loyal to the municipal plant, as is manifested by the continual increase in connected customers in the face of a company rate 20 per cent. lower than the city rate, so that in some five years of operation the city plant has gained a patronage equal to that of the company. These loyal supporters deserve consideration and it would seem that the danger of loss of votes among them from this time on would be nearly as great as that of loss of votes among the customers of the company's plant. That the voters have been in favor of the municipal plant is shown by the votes for bond issues for its construction, the first bond issue for the street lighting plant receiving a bare majority, while later issues for its enlargement to extend the commercial service over the entire city have had very large majorities.

If the city administration will now force the company to justify its power rates or raise them to the schedule fixed by the ordinance, it will either have the ammunition for an extension of its campaign by the passage of a similar ordinance covering lighting rates or it will have a demonstration that the company can supply electric current cheaper than the city can. Then an ordinance fixing the company's schedule as the legal rate card would secure the citizens their light at low figures.

The questions then to be solved would be, first, whether the city plant could afford to operate on the lower schedule, and second, whether, if it could not, the city could afford to pay the deficits in order to keep the plant in operation as a check on undue influences tending to amendments of the ordinance to increase the rates again.

The company contends that the plant is now operating at the expense of the taxpayers and it or someone in its behalf is guilty of some very flagrant misrepresentations of fact to give color to this claim. The justification of the existence of the plant lies in its financial success so that it is essential that the exact facts be known to the voters in case the agitation against the municipal plant brings the question before them for decision in any form.

MUNICIPAL ENGINEERING is not an advocate of municipal ownership, neither is it opposed to it if properly administered, and is only interested in presenting the facts. In the absence of an expert investigation of the situation by an unbiased state or other commission, the following brief analysis of the financial operation of the plant is presented in as impartial a manner as possible, in the hope that it will show the validity of any objections which are well based and the falsity of such as are evidently misrepresentations. The figures in the annual reports of the plant are used as there has been no suggestion that they are incorrect.

Capitalization

The plant was built out of the following funds:

Taxes, to pay bonds and interest	$123,026.06
Borrowed from general fund but carried as an indebtedness of the plant	40,000.00
Bond issues, being $325,000, less $35,000 included in "Taxes" above	290,000.00
Used from depreciation reserve	78,933.73
Used from surplus account	26,482.38
Total of plant account	$445,416.11
Total cost of plant	$558,442.17

The total cost of plant is given on p. 12, of the report for 1912 as $558,331.97. The company's statement is $35,000 higher than this because it has counted the bonds paid, twice. Deducting the depreciation above, the present value of the plant, July 1, 1912, was $479,508.44. This is very nearly that given on p. 12 of the report when the inventory of construction material on hand and not yet made a part of the plant is deducted.

Interest should be computed on this amount, rather than on the bonded indebtedness only, and this has apparently been done in the table of method of financing the plant on p. 1 of the report, the total difference between allowance and actual payments being $41,757.03. The interest allowance in 1912-13 would be $19,100 as compared with $11,825 due.

It is evident that the $163,026.06 from city funds should be considered as an indebtedness of the plant, as $40,000 of it evidently is, and that, if the plant is to be considered as entirely self-supporting, this amount should be repaid to the city with interest. On the other hand, the voters of the city, as represented in the city government, may consider that the plant is so valuable to the city and to its citizens that they are willing to make this contribution to its construction out of the general funds of the city. The city officials justify it by the estimate that, by the difference between the current 10-cent rate in other cities served by the company and the 4 and 5-cent rates in Pasadena charged by the company and the city respectively, the users of light and power in the city saved $200,000 in the fiscal year 1911-12, less amounts in previous years and greater amounts probable in coming years because of increase in patronage. The fact that the saving in one year more than covers the whole contribution from city funds, overshadows any question as to the fairness of producing a saving for light consumers at the expense of the taxpayers at large, whether users of light or not, especially in a city of the exceptional character of Pasadena. The city can afford to pay the whole bond issue and interest on it if this showing is even approximately correct.

Saving to Consumers

The saving to light consumers is estimated from the charges for commercial light and power in the municipal plant for a year at the present rates, $81,389.56 in 1911-12, adding thereto the difference between these rates and those prevalent elsewhere under the company, the base rate being double and minima still larger, thus showing a saving to customers of the municipal plant approximating $100,000. The company's customers, whose present rates are 20 per cent. less, have saved a still greater amount, assuming that it has an equal number of customers, so that the estimate of $200,000 saving to current users is exaggerated but little, if any.

Depreciation Allowances

The company claims that the depreciation allowance should be $12,145.89 greater but gives no reason. The city computes depreciation on a detailed schedule with such items as station equipment, 4 per cent.; overhead construction in six items, running from 2 to 6.4 per cent.; transformers and meters, 4 per cent. each; street fixtures, 5 and 8 1-3 per cent.; buildings, 5 per cent.; and three "personal property" items, 10 and 20 per cent. The average percentage of depreciation in 1911-12 was very nearly 4 per cent. of the valuation before deduction. There is room for difference of opinion, but no method of computation is offered by the company as justification for its claim for adding about 15 per cent. to that so carefully computed by the city.

No reason is given for additions to repair account, disconnections, operating

expenses, insurance, bad debts, injuries and damages, amounting to $25,720.56, altho they are stated to the cents. Possibly they are computed on the company's experience, or on an average of several years or several plants. Why such assumptions should be made rather than to use the exact figures it is hard to see. Such bookkeeping would effectually conceal the results of operation of the plant and the effects of efficient and economical service, and still these figures are used in an attempt to demonstrate a deficit in operation which the facts do not show. The city plant is carrying a surplus to take care of variations in such accounts, which amounted to $18,191.07 on January 1, notwithstanding a special draft of $9,000 upon it for damages on account of an accident. Criticism of the amount of surplus or working capital would be admissible, even if not demonstrated to be correct, but the additions proposed are without theoretical basis as well as being untrue.

An allowance of $804 for rent of office should be made as a credit to the city as the plant pays no rent for its office in the city hall annex.

Ordinarily an allowance for taxes of something like the $4,939.40 claimed by the company as reasonable would be made. This is about one per cent. of the present value of the plant. However, the state is the loser in California, as the taxes on the operative property of corporations of this sort go to the state and the city would actually receive not more than 10 per cent. of the proposed charge for taxes. Whatever this amount may be should be credited to the city and charged to the plant.

An overcharge of $11,011.66 on street lighting is claimed by the company's figures. No reason for this claim is given but there is a statement somewhere that the cost of street lighting per capita of population is higher than in other cities. Wealthy cities with broad streets and large lots are often willing to pay for even more light than is usual, but the same amount of light costs much more per capita, on account of the less density of population. Cost per capita of street lighting, bears little relation to economy in plant management or cost of electric current in comparison with other factors governing the method of measurement.

The fact is that the Pasadena plant charges the same for arc lights as other cities in the same district, and less for ornamental lighting, the charge for the latter being 2.676 cents per kw. hr., while Los Angeles pays the company 4 cents and other southern California cities pay 4 to 7 cents per kw. hr.

Again the statement is made that the average rate charged for commercial light and power is higher in the Pasadena municipal plant than in Los Angeles. This may be true and still the Pasadena rates be the lowest and the saving to Pasadena consumers large. The suppressed fact that 72 per cent. of the current used in Pasadena is for commercial lighting and that 76 per cent. of the Los Angeles current is used for power explains the seeming paradox, for much of the Pasadena current is paid for at 4 and 5 cents for light, while much of the Los Angeles current is paid for at 2 cents or less for power. The true meaning of such a statement being known its lack of application to the case is evident.

The city of Pasadena employed William Dolge, a certified public accountant from San Francisco, to make an audit of the books of the electric light and water plants of the city. The following figures are taken from his balance sheet as of March 29, 1913, and bring the information concerning the financial condition of the plant down to date:

The capital account shows the total property account as given in a detailed schedule, to be $580,745.23, from which depreciation according to a detailed schedule amounting to $95,679.32 is deducted, leaving the total assets, $485,-065.91.

Liabilities include bonds, $325,000, original issue, less $38,750 paid,

Leaving unpaid	$286,250.00
Premiums on bonds sold was	3,836.43
Contributions from city taxes were	175,222.30
A total of	$465,308.73
Leaving a credit balance of profits in operation invested in the plant of	$ 19,757.18

The contributions from city taxes are thus carried as a liability of the plant. The items making up this total are as follows:

Taxes of 1906	$ 52,332.35
Balance of 1911 lighting appropriation	2,299.95
Bond interest to June 30, 1912.	41,518.75
Bonds redeemed to June 30, 1912	26,875.00
Bond interest to March 29, 1913, add'l	8,446.25
Bonds redeemed to March 29, 1913, add'l	3,750.00
Loan from general fund	40,000.00
Total	$175,222.30

The surplus from operation is computed as follows:

On the credit side:

The balance from above capital account	$ 19,757.18
Inventories, assuming them the same on March 29 as on January 1, as shown on a detailed schedule, in the semi-annual report of that date..	17,035.40
Personal property, cost $9,240.33, for autos, office equipment, etc., less depreciation.	7,855.37
Accounts receivable, due for light, power and street lighting, service rendered	14,767.86
Cash on hand	3,984.09
Total	$ 63,399.90

There is one charge against this of $35.00 for deposits of customers on hand, leaving $63,364.90 as the profit on operations after deducting bond interest paid and depreciation.

This profit is taken care of in the following accounts:

Reserve for interest on investment	$20,813.29
Gain on operating for 9 months, ending March 29, 1913	24,360.54
Surplus	18,191.07
Total as above	$63,399.90

The gain on operating shown is the balance on operating account March 29, 1913, of $50,937.34 reduced by deducting nine months' depreciation of $18,130.55 and the bond interest paid as shown in the capital account, $8,446.25.

From the annual report of the plant of June 30, 1912, the reserve for interest on investment to that date may be computed by adding two items and is $75,150.79.

Mr. Dolge says with respect to this:

"The reserve for interest on the average investment is an attempt to show upon the books of the lighting department the interest that would have to be earned upon the total capital investment if the plant were privately owned. There is no particular objection to such an account; however, it must be manifest that any credit balance appearing after bond interest has been charged off is part of the surplus profits, by whatever name designated.

"It would seem contrary to the best interests of the citizens of Pasadena to maintain a big reserve account for interest on the average investment merely because privately owned concerns are supposed to earn such interest. The department might with equal logic be called upon to set up a reserve for taxes which it does not have to pay."

He deducts from it bond interest of $12,818.75 paid out of operating surplus prior to June 30, 1912, and $41,518.75 bond interest paid out of taxes, leaving the balance of $20,813.29 as shown above, which is surplus additional to the $18,191.07 shown under that name.

The indebtedness of the plant on which interest should be paid by the plant is, according to the above statement of liabilities, the bonded indebtedness of $286,250 plus the contributions from taxes of $175,222.30, making a total of $461,472.30, about $24,000 less than the present value of the plant, the interest on which amounts to some $7,000 a year more than is actually paid. No one can object to the use of the profits of the plant in construction and the payment of bonds and interest out of the city treasury, if that is the most convenient and economical mode of procedure, but the accounts should show this clearly and the accounts of "Contributions from Taxes" and "Reserve for Interest on Investment" must show these facts clearly and the allowances to be made for them. The superintendent has tried to do this and should continue to do so. The net balance of interest reserve may be a portion of the surplus, but it must show the facts and should be kept as a separate account.

SEWAGE PURIFICATION

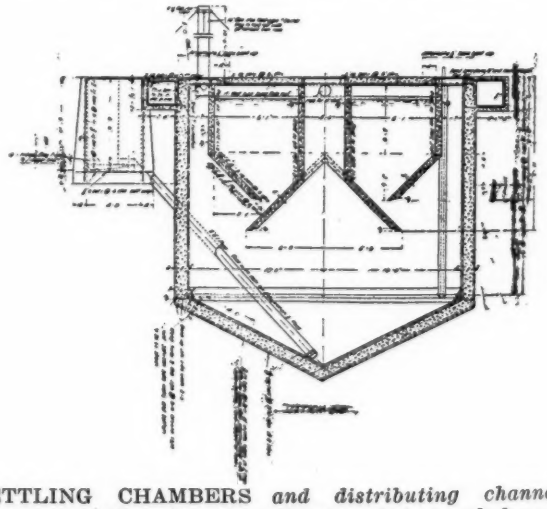
By F. H. Tibbetts, Haviland, Dozier and Tibbetts, Civil Engineers, San Francisco, Cal.

The sewage disposal works at Winters have been designed to accommodate a population of 3,000, which is twice the present number, so that no enlargement of the work will be necessary in the near future. The estimated daily sewage flow is 75 gal. per capita, 225,000 gal. for the assumed population of 3,000. There are two tank units with sludge digesting chambers capable of storing six months' sludge production. The chambers are 20 ft. in diameter and have an effective depth for storing sludge of 6½ ft.; the sludge capacity amounts to 1,950 cu. ft. for each tank or a total of 3,900 cu. ft. Estimating the amount of sludge at 0.007 cu. ft. per capita per day the amount from 3,000 persons therefore would be about 3,780 cu. ft. in six months.

Cross section of one of the tanks, showing method of applying the Imhoff principle is shown in the accompanying drawing. Communication between the upper and lower chambers of each unit is afforded by 10-in. slots. The trough bottoms slope toward the slots at an angle of 45 deg. which is assumed to be steep enough to allow the solids which settle on them to slide down and pass into the sludge chamber.

The sewage as it enters the sedimentation tank passes under two scum boards set 1 ft. apart with their lower edges 18 in. below the water surface. These will intercept floating matter and if the scum forms back of or between the boards it may be removed by raising the planks which cover this space. The arrangement at the outlet end of the tanks is identical with the inlet and provision is made for reversing the direction of flow periodically so as not to get a greater accumulation of sludge in one tank than in the other. The bottom of the sludge digesting chamber is an inverted cone with a height of 5 ft. and a diameter of 20 ft. The depth of sewage will be such that the sludge at the bottom will be under 19 ft. of water.

When the sludge is being removed water may be discharged into it from five points to stir it up and make it slide down to the intake of the sludge pipe. Around the base of the vertical walls at the beginning of the bottom slope is a 2-in. water pipe for flushing, dimly shown in the drawing. There are four 1-in. openings spaced around the tank at 90-deg. intervals and a branch running to the lowest point of the tank. Sludge is to be removed from each by an 8-in. outlet pipe of cast iron coated with coal tar to protect it from the action of the sewage. The intake end of this pipe is at the lowest point of the sludge chamber and the discharge end is in a square concrete manhole 5 ft. below the sewage end of the tank and is fitted with a shear gate. When this gate is opened the sludge will be forced into the manhole from the bottom of the sludge chamber by a 5-ft. head of water and from here will flow by grav-

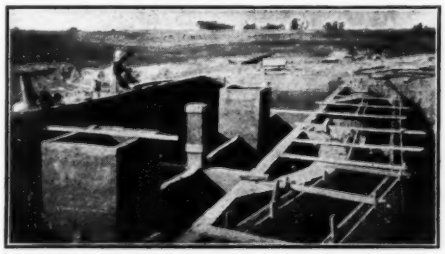


SETTLING CHAMBERS *and distributing channels above; sludge digesting chamber below; sludge removal pipe to manhole on left.*

ity to the sludge drying bed. This pipe is seen in the drawing, extending diagonally up from the bottom of the tank to the bottom of the manhole at the left.

The tanks are covered by a reinforced concrete roof 6 inches thick, high enough above the sewage surface to allow the formation of a sludge mat. Manholes 18 by 36 inches at the side and one 24 by 36 at the center of each tank are provided for removing this mat if it becomes necessary to do so. All parts of the roof of the sludge chamber slope toward one of these three manholes so that the gas bubbles from the working sludge will have free passage to the vents. A 10-inch galvanized iron pipe connects with each of the three gas chambers and extends 10 feet above the roof.

To give complete control of operation a 2-foot concrete channel to carry the sewage runs entirely around the tank and is provided with stop planks so that the sewage may run thru both tanks in reverse direction, thru the first tank only or by-pass both tanks. The major part of the sedimentation will take place in the first tank and it is proposed to reverse the flow thru the system every week or so in order to equalize the accumulation of sludge. If it should prove that one tank is sufficient for the present population to be served, the second tank may be by-passed and held in reserve until needed. The tanks are located near the site of a proposed public park. For this reason it was considered advisable to cover them.



IMHOFF TANKS *at Santa Maria, Cal. Manholes, partition between tanks and other distributing channels.*

Operating Results at Winters

The Imhoff tanks at Winters have not been in operation long enough to give very definite ideas of what may be expected of them, as they were first put into service less than a year ago. The operation has been under the supervision of Mr. Luke Gregory, who, altho without experience in sewage disposal, has given unusually careful and intelligent supervision. Three progress reports have been obtained from assistant engineers since that time, but no analyses have been attempted. The last inspection was made on September 20, by the writer, in company with Mr. Gregory. The system is completed but all the houses have not yet been connected and the amount of domestic sewage delivered is much less than that for which the tanks were designed. The effluent from the tanks has been quite clear and comparatively free from solids, except at times some finely divided black humus matter. At first, while the flow was very small, a slight odor might be detected, but this appears to be hardly perceptible at present. During the greater part of the period of operation only one tank has been used. Lately a part of the sewage has been diverted so as to enter the outer end of each unit, being taken off at the center opening. This makes the tanks operate in parallel rather than in series as was intended.

Bacterial action is decidedly active, as evidenced by the continual rising of large quantities of gas bubbles. Most of these bubbles rise in the center manhole, which collects gas from the largest portion of the sludge wells. Altho gas was escaping in large quantities, no odor of hydrogen sulphide could be detected, even close to the open manholes. The heaviest mat was found in the center manhole of the first tank. This was about 5 inches thick, the manhole being 3 by 4 feet. All of the other floating solids would probably be not more than 6 more cubic feet making in all about 12 cubic feet of floating solid material in the entire tank. This is a very small quantity compared to the amount of material usually found in the floating mat of a septic tank, and indicates that a large proportion of the solids do not hold

enough gas to keep them continually floating. The mat was similar to that usually found on a septic tank, and when judged by the odors given off was not nearly so offensive. Some of the material from the lower part of this mat was taken out and examined. It consisted of a black homogenous mass containing very little fibrous material and having little odor other than that suggestive of tar or crude oil. The mat on the side manhole of the first tank was but about two inches thick, similar in appearance to that in the center. Bubbles were rising here also, but in not nearly such large quantities as appeared in the center. Bubbles were rising here also, but in not nearly such large quantities as appeared in the center. This was due also in part to the fact that most of the solids fall nearer the center of the tank, after passing thru the slots from the sedimentation chamber.

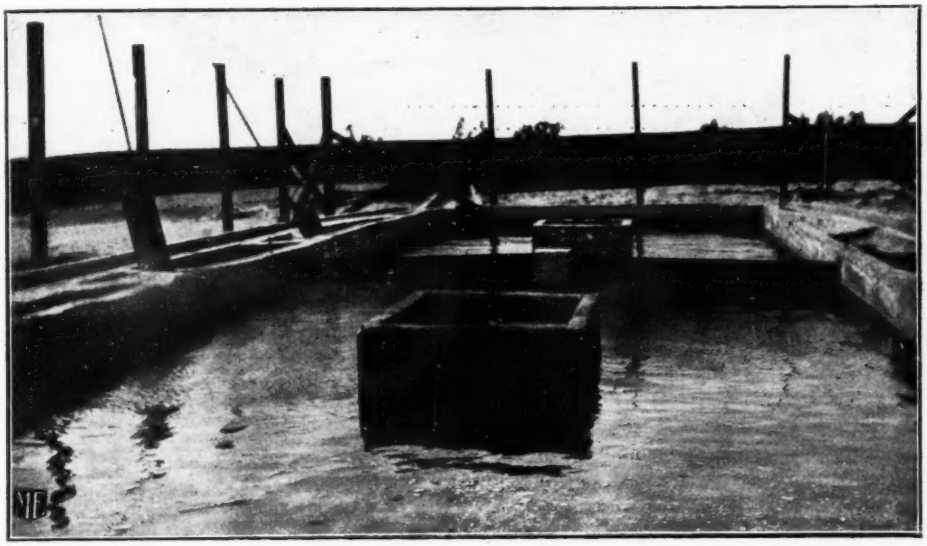
The sludge deposited in the bottom of the tank has been measured by Mr. Gregory, who found it to be about 2 feet thick. No sludge has yet been drawn out. Since the capacity of the sludge well permits of an accumulation of something over 6 feet, before this will become necessary, no observations on the character of the sludge from the bottom have yet been made.

It was found that a slight mat had formed on the sedimentation chamber longest in use. This mat was very thin, probably not over one-half inch, and its origin has not been definitely ascertained. The slope of the partitions between the sedimentation chamber and the sludge wells is 45 degrees, or one on one. It may be that some finely divided solids have remained on this surface for a period long enough for putrefaction to set in and have bubbles form, causing them to float. Or it may be that, as was observed in the Philadelphia experimental tanks, some solids are contained in the sewage which are light enough to float of themselves. Gas and scum is so small compared to the amount of sewage passing thru, that it cannot be a serious defect. Later designs of Imhoff tanks call for slopes of one horizontal to one and one-half vertical for these surfaces, and perhaps with such steeper slopes there would be less tendency for scum to form in the sedimentation chambers.

As will be noted from the description, a cover has been placed on the tanks. This was done in spite of the fact that both Dr. Imhoff and Dr. Rudolph Herring, of New York, considered it unnecessary. In general, a cover is, undoubtedly, not required. The writer however, believes it better to cover any sewage disposal works operated in close proximity to residences, as there is undoubtedly less odor in any type of works which is covered. At Winters, the pipes arranged for conducting the gas from the tanks have been brought together and extended so that the point of discharge is now about 30 feet above the ground. The operator states that previous to this there were on quiet mornings objectionable odors in the immediate vicinity of the tanks. This condition was relieved upon the extension of the pipes. The effluent has been concentrated in a closed iron pipe and taken down to the creek bed where it flows thru a channel in the gravel for a distance of about 100 feet to the main stream of the creek, which is very low at this season of the year. The only odors noticeable about the entire plant were in the 100-foot channel thru the gravel. This could be readily eliminated by diverting the flow of the creek so that the point of discharge of the tank would be under water.

The cover has been found efficient in preventing the use of the tanks as a breeding place for mosquitoes, and the operator has found it desirable to make all openings as nearly tight as possible except for the gas pipes and effluent pipes.

During the summer months a large amount of cannery waste, estimated by the operator as high as 150,000 gallons in 10 hours, was discharged into the sewers, and found its way to the tanks. This material is strongly alkaline from the use of lye in the fruit canning process. It is stated by the operator that upon its arrival at the tanks, sludge decomposition as evidenced by the formation of gas bubbles ceased. Also that the



OPEN IMHOFF TANKS *at Santa Maria, Cal., after six months' use.*

velocity of flow thru the tanks was too high to admit of thoro sedimentation, and that at such times objectionable odors were given off and the effluent was dark and contained considerable suspended solids. Normal action was quickly resumed, however, when the cannery wastes were diverted from the disposal works.

Tanks at Santa Maria

Similar tanks have been constructed at Santa Maria, Cal., and were completed by us about six or seven months ago. These tanks are not covered, and the photographs show the layout and appearance of the tanks better than could be done with photographs of the Winters installation.

Cost of Operation

The cost of operation has so far been nominal in both places. Both are small towns containing from 1,500 to 3,000 population and regularly employ a sewer inspector and engineer at a monthly salary of $75 to $125, whose business it is to inspect all connections, and plumbing, to attend to flushing out the sewers, and to give whatever incidental attention is necessary to the disposal works, the latter consisting usually of a visit two or three times a week for an hour or so.

Relative Cost of Imhoff Tanks and Ordinary Septic Tanks

For comparative purposes, costs have been calculated per capita for two Imhoff tanks and for two ordinary septic tanks, recently designed by the firm with which the writer is associated. The costs are from actual contract prices. The capacities of the tanks are calculated on the basis of a sewage flow of 75 gal. per capita per day, with a 3-hour storage period for the Imhoff tank sedimentation chambers, and an 8-hour storage period for the septic tanks. All four designs are of first-class construction of reinforced concrete at locations at which the prices of labor and materials should be about constant. Later studies indicate that a 2-hour sedimentation period gives good results. The relative costs are shown in the following table:

IMHOFF TANKS.

	Winters.	Santa Maria.
Contract price	$3,414	$4,000
Capacity of sedimentation chambers (cu. ft.)	4,280	3,964
Population Capacity—3-hr. storage period	3,424	3,170
Cost per capita—3-hr. storage period	$1.00	$1.26
Population capacity—2-hr. storage period	5,140	4,760
Cost per capital—2-hr storage period	$0.67	$0.94

SEPTIC TANKS.

	Pleasanton.	Lindsay.
Contract price	$6,667	$8,250
Capacity in cu. ft.	14,560	17,470
Population capacity—8-hr. period	4,368	5,240
Cost per capita	$1.52	$1.57

Conclusions

As compared with standard septic tanks, the advantage of Imhoff tanks can be stated as follows:

1. The construction of the tanks is such that gas from the decomposing solids is unable to rise thru the flowing sewage, and hence does not cause the turbidity of the effluent so common in septic tanks.

2. The sludge decomposition occurs in deep chambers, so that the gas is compressed in such a way as to remove the mechanical difficulties of sludge disposal, and the sludge after drying is easier to handle.

3. The gas generated is free from sulphuretted hydrogen and in general is quite inodorous.

4. The effluent, being delivered in a non-septic condition and comparatively fresh, is much less offensive and much more easy to deal with by subsequent treatment, whether by disposal on land, by dilution or by secondary works, such as filters.

5. The cost is one-third to one-half less than that of septic tanks of the same type of construction.

6. While no studies have been made to determine the exact proportions of sludge removed from the sewage by the Winters and Santa Maria tanks, and while no reports are available on the chemical or bacteriological content of the raw sewage and the effluent, it is believed from the standard of the non-technical observer that the plant is doing, and will do, what is expected of it.

7. There seems little room for doubt that under any ordinary conditions of sewage disposal the Imhoff tank is simpler, quicker in operation, less offensive and cheaper than the ordinary type of septic tanks.

TRANSPORTATION LINES AND CITY PLANNING

At the Chicago City Planning Conference Milo R. Maltbie, of the New York Public Service Commission, discussed city transportation facilities in relation to city planning, demonstrating the following statements:

(1) Main arteries should be straight lines.

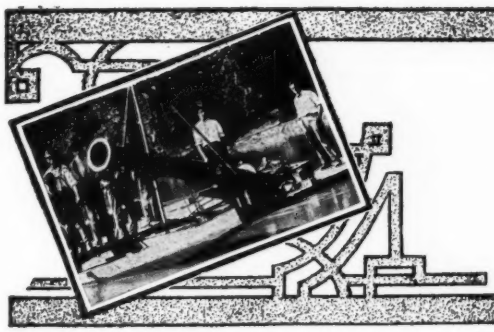
(2) When the growth of traffic necessitates the provision of separate lines for (A) urban and (B) suburban and interurban traffic, the latter should not be permitted to stop at the outskirts and transfer to the urban system. They should be required to operate thru or across the city and do their own distribution and collection of traffic, as far as practicable.

(3) Thru lines should be adopted in preference to terminals.

(4) Elevated lines are less costly than subways and have many advantages.

(5) Freight should be delivered near the center of the city, and space utilized over and under freight yards. City and local electric lines can be used to distribute food products at night.

(6) The municipality should have perpetual control over transit facilities, so that their development may keep pace with that of the city.



EDITORIAL

ROAD MATERIAL AND MAINTENANCE

The report of investigations into the present methods and cost of building roads and maintaining them in Ashtabula county, Ohio, which is discussed elsewhere in this number of Municipal Engineering, again points the moral of the frequent sermons appearing in this department on the fitting of the material for the wearing surface of a road to the work required of it, and the necessity of even more attention to maintenance than to construction, especially if the lighter and softer materials are used for construction and traffic develops unexpectedly.

Too little attention has been paid and is yet paid to the increase in traffic which is certain on almost any main road as soon as the road grade and surfaces and the bridges are put in shape to carry it. The new motor traffic in particular is only waiting the opportunity to develop in a manner and to an extent only very slightly foreshadowed by the increase in such traffic in a few localities, most of them adjacent to large cities, where the roads have been improved sufficiently to admit it. What material shall be used for such main roads is therefore a much more important question than the ordinary county commissioner is disposed to think it. A few reports like that of Mr. Andrews will show these facts to enough people under different conditions to bring some more consideration.

The report shows also a lack of co-ordination of the forces constructing and maintaining roads which is altogether too common and a lack of system in keeping accounts and data of cost of construction and maintenance which leads to waste as well as to errors in plans for construction, maintenance and reconstruction which cause serious mis-applications of funds in all three. But those are other stories.

THE ENGINEER AND THE PUBLIC

The deficiency in the education of the average engineer with respect to his presentation of his work in good English in such form as to be con-

vincing to the reader or hearer who must be interested in what he is saying is likely to be overcome by means of courses in Engineering English, which are being established in various technical schools.

MUNICIPAL ENGINEERING has called attention to this deficiency at intervals from the beginning of its existence; not so much because it is difficult to get engineers to supply the material about his work which the editor wants and in the form in which he wants it, altho that has long been a source of complaint about him; but because the engineer generally is not able to express himself in the manner which impresses the value of his work upon the public.

How often is the credit for a large constructive program taken by one who is able to put the parts of the project together and place them vividly before the public, when the actual development of the program in all its details, and often in its larger relations, has been worked out by the engineer, who stands modestly in the background, or is not heard when he presents his project because he cannot present it convincingly and interestingly to the non-technical investors or taxpayers, whose money alone can make the construction possible!

How many really second-class engineers there are, or men with no engineering ability or education, who have extensive reputations, but who are surpassed in every way but the power of expression by engineers who are seldom heard of but are classed as the "best by every test," but this one, by those who know them and their work!

The engineering publications are always anxious for the information about engineering projects and constructions, expressed in modest but strong and convincing manner, and would gladly displace with such material the matter which now too often has very close to the front the element of advertisement of the engineer or the projectors or the methods and materials used, and therefore is not so reliable nor, indeed, such good advertising material as the straightforward statement of methods, results, reasons and conclusions.

The engineering press is, however, more interested in the advancement of the profession and will do all it can to promote the establishment of such special courses in Engineering English as are now developing and being considered in several technical schools. Some of them have been at work long enough to show results, indicating the correctness of the opinion that this is one of the most important methods of securing general and full recognition of the engineering profession.

QUESTION DEPARTMENT

Information About Garbage Disposal

We are in receipt of copy of MUNICIPAL ENGINEERING, for which we thank you. You have a medium which should have a wide circulation, for in our opinion there is no field today where wasted values are given less attention by experienced engineers than in the cities of this country, although some excellent work in this direction has been done in recent years. The efficiency and scrupulous economy which prevail in many private industrial plants can be applied to a considerable degree in solving numerous and costly problems involved in the government of our American cities, and a more prudent expenditure of the vast revenues annually collected certainly can be effected if the services of trained men are employed, as in private works, to devise means for the preventing or recovery and utilizing of the waste now so general, to say nothing of better sanitation.

Our experience in developing and installing apparatus and processes for treating packing house by-products, under rigid government sanitary inspection, has taught us that the by-products of our municipalities can be handled by more sanitary methods, and also be made a source of substantial revenue.

At the present time we are particularly interested in the collection and disposal of garbage, and if you have any special numbers of comparatively recent date treating on this subject, or the subject of sewage disposal, we would request that you mail same to us.

H. F. ———, New York City.

There is a long list of previous articles on the subject of garbage collection and disposal on page 252 of vol. xlii, of MUNICIPAL ENGINEERING. Other articles in vol. xlii are "Automobile Garbage Trucks in Cleveland," page 328; "Street Cleaning and Garbage and Refuse Collection and Disposal," page 468.

In vol. xliii are several articles, such as "Motor Garbage Trucks in Homestead, Pa.," p. 53; "An Individual Garbage Destructor," p. 257; "Chicago Garbage Removal," p. 327; "A Book on Garbage Destructors," p. 329; "Methods of Garbage Collection," p. 391.

In the current vol. xliv are the following: "Automobile Truck for Refuse and Street Sweeping," p. 119; "Garbage Reduction in Chicago," p. 137.

The department of "Improvement and Contracting News" gives the latest concerning projects for cities.

Modern Gas Ordinance

There has been submitted to the City Commission of this city, at its last meeting, the following proposition:

An ordinance granting certain privileges to the company (a corporation) organized under the laws of the State of Arizona, its successors and assigns, in relation to the use of the streets and public places in the city of ———, N. D., for the purpose of laying pipes, mains and apparatus for the conveyance of gas, and to supply said city and its inhabitants with said gas.

What I want to get is a copy of the most up to date gas franchise, that is, most up to date in safeguarding the rights of the city, both at the present and in the future.

PRES. CITY COMMISSION.

MUNICIPAL ENGINEERING for March, 1912, contains a modern gas franchise, with due protection to both sides in the contract. The arbitration provided for in it has been operated once.

Slag for Concrete Curb

Can you advise me as to the merits of limestone vs. slag for concrete curb construction? If you can give me any comparative tests I will appreciate it.

J. N., ———, Ohio.

Can our readers give any information on this subject? The experience in the use of slag in concrete construction, indicates that it would not work well in outside surfaces of concrete. It will do well for foundations and for masses of concrete but it is probable that slag from any source would contain more or less material which would be acted upon by the weather and would stain or disintegrate the curb.

Regulation for Fire Protection—Business License Fees

1. I shall be very pleased to get some ordinances relative to fire regulation of a city of 3,000.

2. Also I will thank you for some basis or equitable rule for fixing licenses, i. e., for merchants, druggists, etc.

J., City Attorney,
——, Utah.

The usual fire ordinances include a definition of the fire limits within which special building regulations are applied, and occasionally building regulations are made for other parts of the city. For a small city this would probably not be necessary, but something like the following would be all that would be needed:

"No person shall use or occupy within the limits of ..... city, any building for the manufacture of turpentine, camphene, fireworks, nitro-glycerine, or other dangerous or easily inflammable or explosive substance, or for the storage of gunpowder in larger quantities than 28 pounds, or for the storage of fireworks of any description whatever. The quantity of gunpowder allowed to be stored under this section shall be secured in metal canisters, with metal stoppers or covers, such canisters not to contain more than 7 pounds each. The introduction of nitro-glycerine within the city limits is hereby prohibited, and any person having the same in his or their possession or under his or their control, within said limits shall be punished in the manner prescribed in section ..... of this ordinance: Provided, that dynamite containing no more than 60 per cent. nitro-glycerine may be brought into the city for the purpose of shipment.

"No person shall have, put or keep any hay, straw, cotton, hemp or wood shavings in stock, or piles without having the same securely enclosed so as to protect them from flying sparks of fire; and no person shall have or place in any stove, grate or furnace, or use in lighting or kindling fires in any private house, store, hotel, shop or other building, any kerosene, gasoline, benzine, naphtha or other highly explosive or inflammable substance.

"No lighted candle or lamp shall be used in any stable, building or other place, where hay, straw, hemp, cotton, flax, rushes, shavings, gunpowder or other combustible material shall be stowed or lodged, unless the same is well secured in a lantern.

"No person shall carry fire in or thru any street, alley or lot in this city, unless the same shall be placed in some close and secure place or vessel.

"No ashes shall be kept or deposited in any part of this city, unless the same be kept or deposited in a close iron, tin, or earthen vessel, or brick or stone ash house, thoroughly secured.

"No personal shall kindle any fire or furnish material for any fire to be made or kindled in any street, alley or vacant place within the city, unless by tinners, plumbers, or other mechanics in pursuing their business, requiring the use of fire, or for the purpose of boiling tar, pitch or oil to be used in the construction or repair of some building or vessel: Provided, that said fire shall be made in some crate or vessel, so that the same shall not emit sparks or otherwise endanger surrounding property.

"Every building more than one story in height shall have a scuttle through the roof and a convenient stairway leading to the same.

"Every chimney hereafter erected within the limits of ..... city shall be so constructed as to admit its being scraped, brushed, or cleaned, and all chimneys, smoke stacks and exhaust pipes shall be so constructed that the tops thereof from whence smoke or steam issues shall be higher than the tops of the surrounding buildings.

"No pipe of any stove, chimney or fire place shall be put up or used, unless the same be conducted into a chimney of stone or brick; and in all cases where a stove pipe passes thru the woodwork of a building it shall be separated from such woodwork at least 4 inches by metal or other incombustible materials.

"No person, firm or corporation or company shall permit the accumulation of boxes, paper, waste or other inflammable substance in the basement of any building or in or upon any building or premises owned or occupied by such person, firm, corporation or company, nor carry on any business, nor keep any shop, mill or other business or premises or either in the city of ..... in such a manner or condition as to endanger such buildings or property or any other shop or mill or other buildings or premises from fire or explosion.

"The chief engineer of the fire department shall have the power, and it shall be his duty to enter any building or enclosure to see whether the same is in a dangerous state, at such times as he may deem it necessary or whenever complaint shall be made to him in writing, and if they are in a dangerous state he shall report the same to the committee on fire department, and if such report is approved by said committee he shall cause such premises to be put in a safe condition. He shall also have power, and it is hereby made his duty to see that all chimneys, smoke-stacks, hearths, fireplaces, firearches, furnaces, ovens, stove pipes, kettles and any structures or apparatus that may be dangerous in promoting or causing fires, are constructed, reconstructed or altered in such a manner as to secure the greatest protection against fire. He shall also have the power, and it is hereby made his duty to require the owner or occupant of any blacksmith shop,

foundry, furnace, mill or other manufactory to erect, alter or reconstruct his chimney or smokestack so as to prevent sparks from passing into the open air, and no person after being so required or notified by the chief engineer to construct or alter any structure or apparatus, shall be permitted to use the same until the requirements to make the same safe shall have been complied with, and every person who shall neglect for 48 hours after being notified in writing or otherwise by the said chief engineer to comply with the requirements of this ordinance shall be punished as hereinafter provided.

"It shall be the duty of the chief engineer of the fire department and the police of the city to make complaints for any violations of the provisions of this ordinance.

"Any violation of or failure to comply with any of the provisions or requirements of this ordinance, or with any direction, notice or requirement given or made by the chief engineer of the fire department in pursuance of the provisions of this ordinance shall be punished by a fine not to exceed $300 and costs of prosecution, and imprisonment in the ..... county jail for a term not exceeding 6 months, or by either in the discretion of the court, and if only a fine and costs be imposed, the court may sentence the offender to imprisonment in the ..... county jail until the payment thereof, for a term not exceeding 3 months.

2. With reference to the subject of licenses: Columbia, S. C., has a very extensive ordinance covering all kinds of business. Much condensed it includes the following classes of business, each item covering one or more of the items included in the ordinance and the prices being for one year:

Merchants—
Wholesale, $15.50.
Retail, $10, $15, $20, $25.
Contractors, $15, $25, $50.
Distillery, $300.
Shows, $10, $25, $200 per day.
Electric Light Co., $150.
Street Railway Co., $300.
Gas Co., $100.
Glass Factory, $75.
Hotels, $25, $50, $75, $100.
Hucksters, $5, $10.
Insurance, $12.50, $20, $30 and up.
Itinerant tradesmen, repairers, etc., $5.
Junk shops, $100.
Kerosene, $100 and $10 and $15 per wagon.
Solicitors, $10.
Artists, $10, $20 and $30.
Architects and Engineers, dentists, lawyers and oculists and physicians, $10, $15 and $25.
Auctioneers, $50.
Agencies, $5, $10, $15, $20, $25, $50, $75, $100, $200.
Repair shops and small manufacturing shops, $10, $5 and $15.
Money lenders and brokers, $25, $50, $75, $100, $300.
Banks, $75 and $1 for each $1,000 capital above $75,000.
Barbers, $2 a chair.
Ice cream, soda, cigar stands, $5.
Billiard tables, $5.
Bowling, shooting, skating, etc., $10, $15 and $25.
Small trades, $5 and $10.
Clairvoyant, $100.
Compress, $25.
Laundries, $10, hand; $25 steam.
Mills and Factories, $10, $20, $25, $50, $100, $150, $200.
Printing offices and newspapers, $10, $25 and $100.
Peddler, $100.
Railroads, $100.
Stables and stockyards, $25, $50 and $100.
Telegraph companies, $100 to $150.
Telephone Co., $300.
Undertakers, $10, $50.
Warehouse, $100.
Wagons, $5, $10, $15, $20.

Regulation of News Stands on Sidewalks

I would like some information regarding ordinances regulating news stands on sidewalks. D., Chicago, Ill.

The city of New York has been fightig the news stands on the street until it has been able to do much toward removing them, especially where they seriously interfered with the traffic. This is so satisfactory that the Merchants' Association made a special effort to prevent a passage of a bill in the legislature which would nullify the work which has been done.

Most cities which treat this subject in their ordinances allow merchants from two to three feet of space next to the buildings in which to display goods, some of them requiring that no less than five feet of clear sidewalk should be left and some of them requiring still more. Detroit allows the merchants to use three feet of sidewalks if the sidewalk is 10 feet or more in width. Quite a number of cities prohibit the sub-leasing of this space to anyone else, thus cutting out fruit and news stands in front of houses not devoted to these purposes inside.

Atlanta, Ga., Bay City, Mich., Camden, N. J., Detroit, Mich., Evansville, Ind., Mt. Vernon, N. Y., are cities from whose ordinances the above has been gathered. The charter of Savannah, Ga., prohibits granting the right to any structure or obstruction in the public street. Nashville,

Tenn., grants permits for fruit stands projecting not more than thirty inches from the building. Some New Jersey towns permit the license of news stands.

The Omaha, Neb., ordinance reads as follows:

"It shall be unlawful for any person to keep or maintain any stand for the sale of fruit, merchandise or other article or thing, upon any sidewalk in the city of Omaha without first obtaining the consent of the occupant of the premises adjacent to which said stand shall be located, and without first taking out a license to be issued by the city clerk upon application to the city clerk and payment to him of the sum of $24.00 for the municipal year or $12.00 per six months: Provided, that all licenses shall terminate either June 30th or December 31st of each year: Provided further, that the granting of any such license shall not authorize or permit the location of any fruit stand in such manner or at such place as in any manner to obstruct sidewalk or to interfere with free travel thereon."

The city of St. Louis has a similar ordinance except the stand is charged the regular merchants license for the same class of business in addition to whatever it must pay the owner of the property for the use of the space in front of it.

Several of the cities mentioned require that all parts of the stand shall be removed from the street whenever it is not actually in use.

Record of Meter Readings

We are endeavoring to secure a book for keeping records of meter readings and numbers and have been referred to you. If you have anything to offer in this line we would appreciate your kindness in sending us a sample page, or giving us full description of same P., Pittsburg, Pa.

The accompanying cuts show the meter card and the heading of the pages of the meter reading record used by the Otis building in Chicago, copy of which is kindly furnished by C. H. Lange, chief engineer of the building. This is for electric current. The record sheet has space at the left for perforations so that it can be kept in a loose-leaf record book.

METER CARD _____ METER READING RECORD FOLIO _____

ROUTE BOOK _____

CONS. LEDGER _____ NAME _____ ROOM NOS. _____

RATE _____ BLDG. NO. _____ SIZE _____ SET _____

DATE	READING	K. W.	BILL	DATE	READING	K. W.	BILL

Machinery for Making Electrolytic Hypochlorite

I am desirous of obtaining the names of firms who make machinery for making electrolytic-hypochlorite for water sterilization, also of devices for controlling the supply of sterilizing solution in proportion to the flow of water in mains and of plant for using hypochlorite of calcium.

Owing to the distance from which the latter has to be carried, I think it may be possible to make electrolytic hypochlorite cheaper. Ordinary salt costs 7 cents per lb., whilst rock salt cost only $12 per ton.

Can you give me any names of firms whom I can correspond with?

W. R., Regina, Can.

Can our readers give any information on this subject? Probably the General Electric Company or the Standard Electro-Utilities Co., of Chicago, could give some references. Makers of the product

METER CARD Folio _____

METER REMOVED SET ENTERED

Meter Location _____ Room Number _____

Name _____

Maker _____ Maker's No _____ Building No _____

65% Demand Amp _____ Volts _____ Size Amp. _____

Index _____ Const _____ Set _____

TESTS

DATE	BY WHOM	$+	$−	DATE	BY WHOM	$+	$−

Meter Reading Record Route Book Cons. Ledger

Meter Removed _____ Reason _____

are Castner Electrolytic Alkali Co., Niagara Falls, N. Y.; Hooker Electro-Chemical Co., 90 Wall St., New York; National Laundry Machinery Co., Dayton, O.; Siemens & Halske Co., 90 West St., New York; Pennsylvania Salt Mfg. Co., 115 Chestnut St., Phialdelphia, Pa.

Sewage Disposal for a Small Town

How would a cesspool system answer for a disposal plant for a town of about 1,500 to 2,000 population, about 4 miles of sewers, by leaving some openings for some of the waste water to leach away? Are there patents on this of any kind?

D., Kane, Pa.

If, as seems probable from the information given, the sewers carry both storm water and sewage, the usual method of operation is to allow the ordinary dry weather flow of sewage to run into the disposal plant and turn the storm water out thru an overflow. Of course, there is a little sewage in this storm water, but so diluted that it is not seriously dangerous. The disposal plant may be a septic tank, which has been termed a "glorified cess-pool of any of the designs now on the market.

There are several patents on this sort of apparatus, the owners of which are listed in the Business Directory published in each number of MUNICIPAL ENGINEERING under the headings "Septic Tanks" and "Sewage Disposal," including the Cameron Septic Tank Company, 352 Monadnock Bldg., Chicago, Ill.; The Merritt Hydraulics Company, 117 N. Front St., Camden, N. J., Sterilization Company, 9 Clinton St., Newark, N. J., Pacific Flush Tank Co., 108 S. La Salle St., Chicago, Ill., and the City Wastes Disposal Co., 156 Fifth Ave., New York City.

Information About Good Roads

We are undertaking a big bond issue for the building of public roads in our county and are in need of any and all information on the subject of good roads, hence I write for a copy of your magazine and anything else you can and will furnish us.

W., County Attorney,
——, Ga.

MUNICIPAL ENGINEERING keeps up with all the advances in road construction and is the best constant source of information.

The United States Office of Public Roads, Department of Agriculture, Washington, D. C., has much material which has been published by the government upon this subject. The American Highway Association, Colorado Building, Washington, D. C., is another source of material. Its good roads year book is a mine of information which can be obtained for one dollar.

There are several text books on road construction which would be of assistance, such as "Byrne's Highway Construction," $5.00; "Baker's Roads and Pavements," $5.00; a part of which is given to roads; "Hubbard's Dust Preventives and Road Binders," $3.00; "Morrison's Highway Engineering," $2.50.

Cost of Hauling on Roads

Kindly advise whether you can give us comparative figures showing the cost of hauling on roads of various countries. I have noticed such tables published but can not locate any at this time. I have reference to a table that would show the cost per ton for certain distances on roads in France, Germany and other countries as compared with the cost of hauling on roads in the Unitetd States. We want these figures in order to substantiate our argument that the United States is far behind on roads.

R., Minneapolis, Minn.

The comparative figures referred to must be indefinite and not distinctly applicable, because the cost per ton of hauling on roads depends on wages, cost of feed for animals and the like, as well as upon grades and characters of surfaces. Better comparisons can be made by means of such figures as those given in the article on "Grade and Surface Required on Roads," which will be found on page 25 of the January number of MUNICIPAL ENGINEERING.

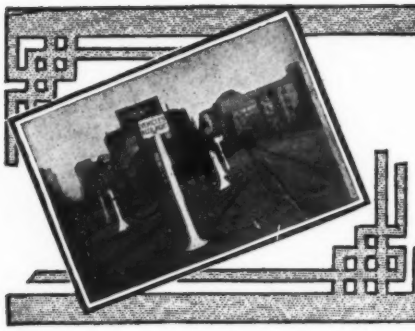
It is no longer true that the United States is far behind in the quality of its best roads. The fact is that the French government has a commission of engineers in this country which is spending an indefinite time in the study of American methods of building roads and their appurtenances and the results thereof. The United States is behind in the mileage of such roads, and the farther west we go the worse the conditions in this respect.

The average figures of cost of hauling two thousand pounds per mile in various parts of the United States were published some years ago by Gen. Roy Stone, when director of the United States Office of Road Inquiry. They have been criticised very severely at various times, but are given for what they are worth:

Eastern, 32 cents; Northern, 27 cents; Middle, 31 cents; Cotton, 25 cents; Prairie, 22 cents; Pac. Coast and Mountain, 22 cents; Whole United States, 25 cents.

In MUNICIPAL ENGINEERING, vol. vi, is a statement that "in Switzerland, 'the best highwayed country in the world,' one horse serves thirty people. In England, where the roads are admirable, the ratio is one to twenty-four. In France it is one to thirteen and a half. In the United States is is one to four, while in Indiana, one horse serves only three people."

Can our readers refer our correspondent to other comparisons of similar nature?



WORKERS IN THE FIELD

Distribution of Accounts of Road Construction

The Editor of MUNICIPAL ENGINEERING:

Sir—On page 328 of your issue for April, 1913, is a query from "G., Tex." regarding accounts. Possibly your correspondent would obtain some information by consulting the report of the State Roads Commission of Maryland on pages 114 to 133.

W. W. CROSBY,
Chief Engineer, Baltimore, Md.

The following, taken from pp. 122 to 126 of the report gives the classification of expenditures in the general accounts and the rules for entering expenditures in primary accounts, which may serve with very few modifications for county road work as well as road work under a state commission:

A—Administration and Legal

1—COMMISSION SALARIES AND EXPENSES.

Salaries paid to the members of the commission, also all expenses when engaged on its work, such as railway fares, team and automobile hire, subsistence and incidental expenses.

2—COMMISSION—SECRETARY'S AND OFFICE EMPLOYES' SALARIES.

Salaries of secretary and all bookkeepers, clerks, stenographers and office boys in main office.

3—COMMISSION—OFFICE EXPENSES.

All office expenses of the commission, such as rents, telegrams, telephones, postage, messengers, books, typewriters, adding machines, stationery and office supplies.

4—COUNSEL'S SALARY, FEES AND EXPENSES.

Salary of counsel, and fees paid other attorneys which, from their nature, cannot be charged direct to a particular road or county. Also the traveling, subsistence and other incidental expenses of counsel when engaged on business of the commission.

B—Engineering

General.

101—ENGINEER'S SALARY AND EXPENSES.

Salary of the chief engineer and his traveling, subsistence and incidental expenses when engaged on the business of the commission.

102—OFFICE EMPLOYES—EXPENSES.

Salaries of the chief engineer's secretary, clerks, stenographers and office boys.

103—OFFICE EXPENSES.

Office expenses of the chief engineer, such as rent, telegrams, telephones, postage, messengers, books, typewriters, adding machines, stakes, instruments, stationery and office supplies.

104—SHOP LABOR AND MATERIAL.

Labor and material used in the shop operated under the direction of the chief engineer.

105—INVESTIGATIONS.

Chemists, physicists or others engaged under the direction of the chief engineer in conducting tests and investigations, together with the cost of materials used in connection therewith.

Preliminary and Construction.

110—ENGINEER'S SALARIES AND EXPENSES.

Salaries and traveling expenses and incidental expenses of division engineers engaged exclusively on preliminary or construction work.

111—RESIDENT ENGINEERS' SALARIES AND EXPENSES.

Salaries, subsistence and incidental expenses of all resident engineers engaged exclusively on preliminary or construction work.

112—OFFICE EMPLOYES' SALARIES.

Salaries of clerks, stenographers, office boys, etc., employed in offices of division engineers.

113—OFFICE EXPENSES.

Office expenses of division engineers, consisting of telegrams, telephones, books, typewriters, stationery and office supplies.

C—Construction—Preliminary

201—SURVEY PARTIES.

Salaries and expenses of engineers and their parties engaged in surveying and locating new roads.

202—DRAFTSMEN.

Salaries of draftsmen engaged in preparing the plans and drawings for the proposed new roads.

D—Construction

All construction work should be done under regular contract or force work orders, which should bear distinctive numbers. An account should be opened for each such piece of work, such accounts to be grouped as to funds from which paid and counties in which work is located.

301—RIGHTS OF WAY AND DAMAGE.

Cost of land acquired for right of way, expenses of appraisals, expenses of commissioners or arbiters in condemnation proceedings, commissions paid for additional rights of way, removal of fences, payments for damages or repairs to abutting property, counsel's fees and expenses when specifically applicable to the cost of acquiring certain right of way and damages paid for delays because of lack of right of way.

302—GRADING.

Cost of grading, including ditch, masonry, culvert and bridge excavation, the excavation covered by the cross sections and from the borrow pits, the cost of operating steam shovels, scrapers and grading outfits, the hire of teams and equipment, rentals for the commission's equipment, rentals and the cost of miscellaneous tools and supplies used on the work. The cost of grading done under contract should be charged to this account from the vouchers in favor of the contractors.

305—SURFACING.

Cost of all labor employed and material used in surfacing, including the cost of operating stone crushers, spreaders, road rollers, sprinklers and oilers, the hire of teams and equipment, rentals for the commission's equipment used, the cost of miscellaneous tools and supplies used on the work, and in addition to the macadam or actual surfacing prescribed in the specifications under such head all paved gutters, curbing, concrete or other breakers across the shoulders when so used particularly and independently of the grading expressly for the purpose of improving the shoulders, and any material, such as sand, cinders or stone dust, used as a layer between the sub-grade and the surfacing proper. The cost of surfacing done under contract should be charged to this account from the vouchers in favor of the contractors.

304—BRIDGES AND CULVERTS.

Cost of labor employed and material used in construction of bridges and culverts, including the hire of teams and equipment, the cost of miscellaneous tools and supplies used on the work, all pipes, boxes, as well as culverts and bridges of all kinds used toward the end of disposing of the storm water coming to the road from above or from the surface of the adjacent lands. The cost of bridging and culverting done under contract should be charged to this account from the vouchers in favor of the contractors.

305—UNDERDRAINS.

Cost of labor employed and material used in construction of underdrains, V-drains, blind drains, sumps, standard underdrains and such other devices as are installed for the purpose of taking care of the ground or sub-surface water, the hire of teams and equipment and the cost of tools and supplies used on the work. The cost of drain work done under contract should be charged to this account from the vouchers in favor of the contractors.

306—ADVERTISING.

Advertising contracts for the work to be let.

307—INSPECTION.

Salaries and expenses of inspectors on the work.

308—SUPERINTENDENCE.

Salaries and expenses of superintendents in charge of work done by the commission's forces.

309—FINAL SURVEYS, PLANS AND ESTIMATES.

Salaries and expenses of engineers and their parties engaged in making final surveys, plans and estimates on the completion of each contract.

310—MISCELLANEOUS.

Rip-rap, tests and such items as are not chargeable under accounts No. 301 to No. 309, inclusive; also the amount of preliminary surveys and plans applicable to each contract when transferred from accounts Nos. 201 to 202.

All items of $50 and over should have explanatory notes made opposite the item in the detail ledger.

E—Reconstruction

401—LABOR AND MATERIALS.

Labor employed and materials used in reconstruction of roads and turnpikes acquired.

402—TEAM HIRE AND USE OF EQUIPMENT.

Hire of teams and equipment and rental for use of commission's equipment on the work. It should include the labor employed and materials used in operating and maintaining the equipment in use.

				Per Cent.	
Total Expense $4,422,520 54	Administration and Legal $62,910 51 1.4 Per Cent.		Commission Salaries and Expenses	50.33	$ 31,666 42
			Commission Secretary and Office Employees' Salaries	23.41	14,728 05
			Commission Office Expenses	16.33	10,273 71
			Counsel's Salary, Fees and Expenses	9.93	6,242 33
	Engineering General $56,318 72 1.3 Per Cent.		Engineer's Salary and Expenses	27.81	15,660 59
			Office Employees' Salaries	28.62	16,118 02
			Office Expenses	37.49	21,116 22
			Shop Labor and Material	5.01	2,820 29
			Tests and Investigations	1.07	603 60
	Preliminary and Construction $4,126,911 46 93.3 Per Cent.	Engineering $56,056 90 1.3 Per Cent.	Engineer's Salary and Expenses	27.96	15,675 81
			Engineer Inspector's Salary and Expenses	38.53	21,598 72
			Office Employees' Salaries	31.54	17,680 85
			Office Expenses	1.97	1,101 52
		Preliminary $59,907 12 1.5 Per Cent.	Survey Parties	34.06	20,405 63
			Draftsmen	65.94	39,501 49
		Construction $4,010,947 44 97.2 Per Cent.	Rights of Way and Damages	6.91	277,157 76
			Grading	15.45	619,652 83
			Surfacing	56.10	2,250,318 16
			Bridges and Culverts	12.65	507,214 33
			Drains	1.20	48,103 13
			Advertising	0.07	2,976 87
			Inspection	2.44	97,677 18
			Superintendence	0.40	16,242 81
			Final Surveys, Estimates and Plans	0.03	1,100 00
			Miscellaneous	0.37	14,789 26
			United Railways Company's Work	4.38	175,705 11
	Reconstruction and Maintenance $128,949 47 2.9 Per Cent.	Engineering $14,293 25 11.1 Per Cent.	Engineers' Salary and Expenses	19.07	2,725 21
			Engineer Inspector's Salary and Expenses	50.82	7,263 66
			Office Employees' Salaries	23.93	3,421 05
			Office Expenses	6.18	883 33
		Reconstruction $16,378 92 12.7 Per Cent.	Labor and Materials	33.65	5,512 12
			Team Hire and Use of Equipment	21.46	3,515 02
			Superintendence	32.20	5,274 14
			Inspection	12.69	2,077 64
		Maintenance $98,277 30 76.2 Per Cent.	Labor	22.20	21,820 41
			Materials	57.31	56,320 75
			Team Hire and Use of Equipment	13.66	13,419 10
			Superintendence	5.77	5,675 98
			Inspection	1.06	1,041 06
	Equipment $47,430 38 1.1 Per Cent.	Construction	Rental charge for average time at 5 per cent. per month equals		14,563 00
		Maintenance	Rental charge for average time at 5 per cent. per month equals		595 00
		Reconstruction	Rental charge for average time at 5 per cent. per month equals		800 00

NOTE:—The above chart and figures are given to show the actual distribution of the total expenditures by the State Roads Commission to December 31, 1911. The segregation into items of work done is given on pages 28, 29, 30 and 31.

403—SUPERINTENDENCE.

Salaries and expenses of superintendents and foremen in charge of reconstruction work.

404—INSPECTION.

Salaries and expenses of inspectors on reconstruction.

405—MISCELLANEOUS.

Tests and such other items as are not chargeable under accounts No. 401 to No. 404, inclusive; all items of $50 and over should have explanatory notes made opposite the item in the detail ledger.

F—Maintenance

501—LABOR.

Labor employed in maintaining existing roads.

502—MATERIALS.

Materials used in the maintenance of existing roads.

503—TEAM HIRE AND USE OF EQUIPMENT.

Use of teams and equipment in the maintenance of existing roads, together with rental for use of commission's equipment so used.

504—SUPERINTENDENCE.

Salaries and expenses of superintendents and foremen.

505—INSPECTION.

Salaries and expenses of inspectors.

506—MISCELLANEOUS.

Tests and such other items as are not chargeable under accounts No. 401 to No. 404, inclusive; all items of $50 and over should have explanatory notes made opposite the item in the detail ledger.

G—Equipment

To this account should be charged the purchase price of all equipment which may have a substantial value after it has been used on any particular piece of work, such as road rollers, crushers, scrapers, graders, sprinklers, horses and wagons, auto trucks, etc. Small tools and other equipment which quickly wear out or become valueless should be charged to the work for which purchased at the time of purchase and upon the completion of such work should be appraised and credited to it.

The commission's equipment should be inventoried and numbered, and a proper record kept thereof. Charges for the use of the equipment should be made against the work on which it is employed, the credits for which may be carried in a "depreciation reserve" or "rental" account.

Rules for Distribution of General Accounts

The monthly total of the engineering expenses, accounts 110-113, specifically applicable to preliminary and construction work, should be charged to Construction Preliminary and to Construction in proportion to the total amounts charged direct to those accounts during the month.

The monthly total of the engineering expenses, accounts 120-123, specifically applicable to reconstruction and maintenance should be charged to Reconstruction and Maintenance in proportion to the total amounts charged to those accounts during the month.

The monthly total of Administration and Legal, accounts 1-4, and of General Engineering, accounts 101-105, expenses should be charged to Construction, Preliminary, Construction, Reconstruction, and Maintenance in proportion to the total amounts charged direct to those accounts during the month, including the specifically apportioned charges for engineering expenses.

Exception: No part of the overhead charges is to be added to the maintenance expenditures made from the allotments of the motor vehicle tax to counties for maintenance of State Aid roads.

Using the above classification of accounts and following the instructions for distribution to the general accounts, the accompanying table shows the expenditures of the Commission to Dec. 31, 1911.

Concrete Pavements in Davenport, Iowa

The Editor of MUNICIPAL ENGINEERING:

Sir—The first concrete pavement in the city of Davenport, Ia., was completed in the fall of 1909 and comprised only a little over 3,000 square yards. In 1910, about 16,000 square yards was laid. This was widely distributed and consisted of small jobs, and the type was considered as a more or less dubious experiment. By the spring of 1911, some of the paving laid to date withstood two winters and two seasons of traffic. Its condition at that time seemed to warrant the continued use of concrete. During 1911 there was laid over 18,000 square yards of concrete paving in the city, and the adjoining town of Bettendorf, with a population of about 900, laid in the summer of 1911 a little over a mile of concrete paving in its main street, consisting of nearly 29,000 square yards in one job.

In 1909-10 the concrete pavement was laid under specifications briefly as follows: A 5-inch base of 1:3:5 concrete, with a wearing surface of 1:1 sand mortar, was corrugated transversely with tooled grooves about 8 inches apart. The mineral aggregate was river sand and 1½-inch crushed limestone. A transverse expansion joint filled with pitch was required every 50 feet. In 1909 the price on the only piece laid was $1.25 per square yard; in 1910 the price varied from $1.27 to $1.37 per square yard. The same year

a number of residence alleys were paved with one course of 1:3:5 concrete 6 inches thick and rough-finished, at an average price of $1.11 per square yard. During the fall and winter of 1910-11, the writer noticed that almost without exception these blocks of paving 50 feet long and 30 feet wide had developed irregular contraction cracks. While these cracks were negligible as to size, they were without question a failure and detrimental to the life of the pavement.

With the idea of a general bettering of the work, and in an endeavor to do so without materially increasing the cost, our specifications were changed before the season of 1911 to call for a 5-inch base of 1:3:5 concrete, with a 2-inch wearing surface of one part cement to two parts sand, a 2-inch transverse expansion joint every 25 feet, and a 1-inch longitudinal expansion joint along either curb, and a 1⅛-inch contraction joint midway between the transverse expansion joints. All joints have tool-rounded edges, and are filled flush with asphalt. This divided the work into blocks of 12½ by 30 feet, and so far has practically eliminated all contraction cracks. The concrete pavement under this specification was laid in 1911 for $1.25 to $1.30 per square yard.

During the season the city also laid several thousand yards of concrete pavement consisting of a single course, 6 inches thick, of 1:2½:4 concrete, with the mortar flushed to the surface, floated, and either broom-finished or corrugated as the grade of the street required. This was laid under contract at a cost of 93 cents to $1.00 per square yard.

During this same season our department was required to pave a street the subsoil of which was decidedly treacherous, consisting largely of sawmill refuse, such as sawdust, chips, bark, etc., filled above the natural surface of the ground to a depth of 6 to 12 feet and saturated with river water. Both railroad and street railway tracks which parallel and adjoin this street settle from 18 to 24 inches annually where they cross this fill. As this street would be subject to heavy and high-speed traffic, in the writer's opinion a flexible type of pavement, such as the various forms of macadam, would neither withstand the traffic without constant repair nor be in the least self-supporting over what seemed almost certainly excessive and unequal settlement.

Owing to the very general demand of property owners last season by petition and otherwise, for concrete paving, the writer has again changed his specifications in the effort to obtain, if possible, the best and most substantial concrete pavement compatible with a moderate first cost. The present specifications call for a 5-inch base of 1:3:5 concrete, upon which is laid a wearing surface not less than 1½ inches in thickness at any point, consisting of one part cement, one part of sand and one part of ¼ to ½-inch granite chips; transverse expansion joints consisting of creosoted long-leaf yellow pine blocks 1 inch in thickness placed with the grain vertical 20 feet apart; and the same longitudinal joints along the curbs as before specified. The prices received so far this season upon the pavement to be built under this specification have varied from $1.00 to $1.17 per square yard.

The writer prepared plans and specifications calling for bids on 29,000 square yards of concrete paving to be mixed 1:2½:4 with mortar flushed to the surface with a bar tamper, floated, and broomed; expansion and contraction joints to be placed dividing the work into blocks 12½ by 20 feet; and all to be filled with an asphalt filler. There were also 18,000 cubic yards of excavating; 11,000 linear feet of 18-inch concrete curb; 12,000 linear feet of 12-inch concrete curb. This latter was placed around a 10-foot center boulevard strip, which was left for the purpose of receiving a probable street railway line. The successful bidder on this work took the contract at 85 cents per square yard, 30 cents per cubic yard for excavation, 18 and 20 cents per foot respectively for the curbing. The ground for this work was first broken in the middle of September, and the pavement was completed and open to traffic in the middle of December.

This pavement was laid by the Hubbell Construction Co., of this city, and a Koehring Special Street Paving Mixer was used in the work.

A. M. COMPTON,
Commissioner of Public Works,
Davenport, Iowa.

Importance of Road Rolling

The Editor of MUNICIPAL ENGINEERING:

Sir—The County Road Commissioners of Menominee county, Michigan, started the development of a maintenance system in the spring of 1909 which promises, when all details have been worked out, to be an economical method of doing the repair and minor improvement work on the county road system.

The commissioners have under their charge 150 miles of road open to traffic. Of this about one-fifth is of gravel road or better; the remainder is of various grades of earth roads and offers problems in maintenance of every kind of bed from loose yellow sand to a clay sandstone hardpan.

Rolled roads are more durable, and in consequence the cost of repair and main-

tenance is greatly reduced. With coarser stone in the roadbed it is stronger to resist wear; and it is more securely bonded than where it is first rutted and mixed with mud. Less stone is required on a rolled road, as loose stone is largely forced down into the mud or is knocked to the ditches by traffic.

A good road should have a foundation of uniform strength, surfaced with a well-bonded coat of stone of uniform thickness. By rolling the sub-grade, weak spots are developed which can be filled with earth and again rolled to produce a uniform foundation. Earth for this purpose is cheaper than stone. When weak spots are brought to grade in this way, an even coat of stone can be applied and rolled to its permanent place. Only a roller will do this work.

Rolling is essential to the construction of a good stone road. It is impossible to build a stone road cheaply and durably without a roller, and the same is true with regard to the best class of gravel roads.

Councils in selecting a steam roller should choose the best; and respective merits should be carefully studied. A saving in first cost may be many times offset by the additional cost of operating or maintaining an inferior machine. Maximum results and fewest stops for repair are all-important in seeking true economy.

Rolling is not an added expense to the cost of a stone road. The cost of rolling is more than made up by the saving that results in several ways.

Coarser stone can be used in a road that is rolled so that the cost of crushing is reduced. Between stone crushed fine enough to be used without rolling, and the coarser stone suitable for a rolled road, there may readily be a difference in cost of from 8 to 10 cents a ton. This alone will nearly pay the cost of rolling limestone.

Roads built without rolling demand a great deal of attention for several years that is not given to rolled roads. The stone has to be raked to place from time to time; the earth sides have to be levelled where they have been cut up and destroyed; new material has to be added to fill hollows and ruts.

The road roller is one of the most important of roadmaking implements. Its use tends to greater durability, and consequent economy of maintenance. The cost of a road is largely dependent upon the amount of stone and gravel required; and by the use of a roller, the strength of the surface coating can be much increased, the drainage made more perfect, the life of the road lengthened, and in a given period a much less quantity of stone is required on the road.

A road should first be properly graded, crowned and drained. The roller should then be used to consolidate this earth sub-soil so that the gravel or stone placed on it will not be forced down into loose earth, but will form a distinct coating. When this foundation is prepared, the metal can be placed over it and rolled and consolidated into distinct crust.

It is one of the cardinal principles of roadmaking that the metal must form a distinct crust over the natural earth. This is not possible if the broken stone is dropped on a loose mound of earth, and is left for traffic to consolidate. To this end:

(a) Roll the earth subsoil before putting on the broken stone or gravel.

(b) Roll the broken stone or gravel until it is thoroughly solid.

A considerable portion of our machinery is supplied by the Port Huron Engine & Thrasher Co., Port Huron, Michigan.

K. I. SAWYER, Road Engineer,
Menominee County, Mich.

Filler for Brick or Wood Block Pavements

The Editor of MUNICIPAL ENGINEERING:

Sir—It is perhaps not an exaggeration to say that the success of block pavements, whether the blocks be of brick, wood, stone or granite, depends to a certain extent upon the filler used; and, furthermore, while paving units in block form exist which perfectly satisfy the requirements, the trouble has been mostly with the binding or filling elements.

The ideal filler is an asphalt artificially treated, so that it will not melt or chip within the range of heat and cold of the greatest of extremes of weather. So effectively does this treated and perfected asphalt take care of expansion and contraction that some paving engineers are using it for expansion joints, where other fillers are used for the body of the work.

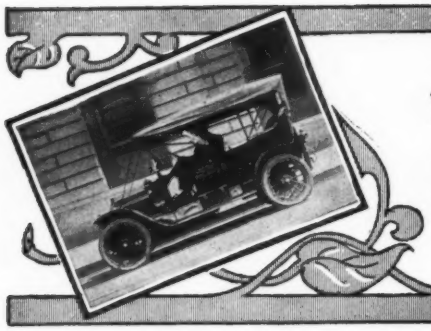
The following table shows the amount required for such purpose:

EXPANSION JOINTS ONE INCH WIDE PER LINEAL FOOT OF JOINT.

12 inches deep	requires 5	lbs. asphalt
10 inches deep	requires 4.166	lbs. asphalt
8 inches deep	requires 3.333	lbs. asphalt
6 inches deep	requires 2.5	lbs. asphalt
4 inches deep	requires 1.666	lbs. asphalt

Used as an expansion joint filler, it makes up partially for the deficiencies of other fillers used with it; used for the whole work it gives a filler that always adheres to the brick and gives a true uniformity flush surface, is waterproof and sanitary; and in repair work can be removed from the units and remelted again and again as well as permitting the reuse of the paving units.

J. A. JOHNSON, Contractor,
Chicago, Ill.



Automobiles in Municipal Service

Motor Trucks in Municipal Contracting

By H. W. Perry, New York.

MUNICIPAL contractors, who are accustomed to handling large jobs, have adopted mechanical aids to their work to replace manual labor to such an extent that it is natural that they should adopt the motor truck to do the work done by horses and mules up to the present time. No work is now done by men on large jobs that can be done as well and quicker and cheaper by machinery. In street paving the concrete foundation and the tar and crushed stone surface composition are mixed on the spot, and in some cases distributed by power mixers that do everything but load themselves and rake the materials to an even thickness. The job is finished by steam or gas engine driven rollers. All that is needed in most cases to make street work an almost entirely mechanical job is motor trucks to haul the material to the mixer. Some contractors already are using them for this purpose.

Excavation work also is nearly all mechanical. On open jobs the steam shovel saves digging by men and hauling the earth and rock out of the hole with teams. In shafts and tunnels steam hoists raise to the surface the material loosened by steam drills. Here the power vehicle can complete the mechanical chain by hauling the rock and earth away to the dump.

In building operations the structural steel and stone are placed in position by steam derrick and the steel is riveted with pneumatic riveters. Possibly in time an ingenious and successful brick laying machine will be devised, but there is now ready at hand a proved mechanical means for hauling all the material that goes into the structure of public buildings. By its speed, reliability, endurance and general convenience it can expedite building operations just as surely as the other mechanical aids of the contractor.

Looking over the field of municipal contracting, it seems somewhat remarkable that, when contractors are so keenly alive to the advantages of the use of the various kinds of improved machinery and employ men trained in its use, they have not almost universally adopted the motor truck. Its advantages are so obvious that the reasons for such apparent backwardness must lie in some other direction. Probably it is due mainly to the fact that contractors very often do not own their teams but make a practice of hiring them.

Contractors Have Awakened

As it is, however, more than 500 Amer-

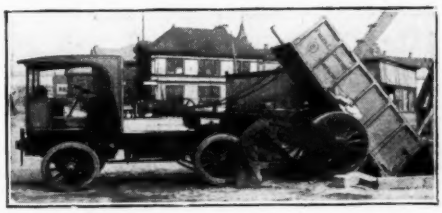
HAULING ASPHALT *paving material in Garford tractor with dump wagon trailer, in Brooklyn Boro, by the Cranford Company.*

ican contractors in all lines of work are using about 750 motor trucks, according to *Power Wagon*. More than 500 of these trucks were purchased during the last year and a half and more than 400 others will go into contracting service this year, says the same authority. This shows that the use of power vehicles is a very recent development among contractors but that it is growing rapidly. So far there are few fleets of trucks in the contracting field, such as there are in express and department store services, from which it is safe to assume that most of the contractors who have them are testing out one machine with the intention of adding others if it does the work satisfactorily. The re-orders and fleets will come a little later. There are, however, half a dozen contracting companies that are using from twelve to twenty motor trucks each and nine or more that are using from six to nine.

The Watson Fleet

One of the largest fleets is that of the Watson Contracting Co., of New York, which now operates eighteen Garford trucks, principally in street work. The company has been engaged recently on four contracts for grading streets and avenues in Bronx boro. The contracts called for the handling of more than 400,000 cubic yards of rock and earth in excavations and fills and also the hauling of crushed stone, screenings, ashes and gravel, cement, sand, coal, asphalt blocks, and other materials required in or incidental to the work. The materials were brought up the Harlem river and discharged by derrick into hoppers on shore, and were discharged from these by gravity into the trucks below. Each truck held five cubic yards and was fitted with a rear dump body, operated by hand-crank at the side.

The following data are given of two regular trips made by these trucks:



SUBWAY BUILDING *in New York, with motor dump truck by F. L. Cranford (Inc.)*

BUILDING STREETS *in Bronx Boro with Garford dump truck and tractor, by Watson Contracting Co.*

and night shifts, were able to make all necessary adjustments and repairs.

According to a member of the Watson company, each motor truck can do work equal to nine horses. On most jobs they have displaced the horses. The company sold forty-four of its horses in January and, having received the ten new trucks that were ordered about that time, will now dispose of all but fifty horses, which will be used in slow work and soft ground.

	First Trip.		Second Trip	
Distance from dock to fill	1¾	miles	1¾	miles
Load Carried	5	cu. yds.	5	cu. yds.
Running time, empty	13	minutes	12	minutes
Running time, loaded	15	minutes	14	minutes
Loading time	1½	minutes	4	minutes
Unloading time	2	minutes	3	minutes
Waiting time	0		3	minutes
Total time	31½	minutes	36	minutes

The material hauled at these trips was screenings; the streets were paved with asphalt blocks; there was one steep, winding grade and weather was good. The driver did not have to leave his seat, as helpers on the road raised the tail boards and tipped the loads. On this schedule, one truck could haul from 83 to 95 cubic yards in a ten-hour day. Two men, working day

Trucks for Bituminous Paving Materials

The Cranford Company, Brooklyn, has a fleet of seven trucks of the same make as the Watson Contracting Company's. They are, however, of the tractor type,

THE POWER DUMP TRUCK *for road building does the work of three to twelve teams. This Mack truck has just spread* 15,000 *pounds of stone as it was dumped, in about* 2½ *minutes' time, more uniformly than if by hand, and with saving of several men. Depth of spread perfectly regulated by driver.*

having a short wheelbase and fitted with a fifth wheel mounted on trunions almost over the rear axle. The trailers used with these tractors are the bottom-dump hopper body wagons formerly drawn by horses. The front wheels and axle have been removed and the necessary provision made for attachment to the tractor, as illustrated. These bodies were built for hauling asphalt for street paving, and are lined with sheet steel and interlined with asbestos to retain the heat.

The tractors have only recently been delivered to the company, so that no data on their performance are available. One of the great advantages of power trucks for asphalt paving is that their speed makes it possible to start with the asphalt heated to just about the proper temperature for spreading and to arrive at the scene of operation in a few minutes without letting the mixture have a chance to cool and harden. Another advantage is that more than half of the weight of the load is carried on the steel tired wheels of the trailer and this materially reduces the wear on the rubber tires.

The Warren Brothers Company, of Boston, has lately been using two five-ton White trucks for hauling material for laying bitulithic pavement in Cambridge. Pressed-steel rear-dumping bodies are fitted. They are elevated by power from the engines of the vehicles. The contractors charged the construction account $15 a day for each truck, but have found that the hauling was done at less cost than that of teaming. Added to this economy was the fact that two motor trucks could be managed with much less confusion and interruption of work than could six or eight teams which would have been required to do the work; also, that the trucks could be utilized, if necessary, after the regular day's work was over, to perform some special service as, for example, making a thirty-mile trip to bring a piece of equipment needed for the following day's work.

The power dump truck is one of the most efficient aids that the contractor can utilize. A truck not only has two or three times the speed of a team, but it can be backed into position in a fraction of the time required with horses and its load of three to seven tons or more can be discharged in a minute or less. By the simple manipulation of a lever from his seat, the driver connects the dumping mechanism with the engine and the engine does the hard work. Many such trucks are now made with automatic tail-opening levers and locks, by means of which it is possible to regulate the discharge as the truck moves forward slowly. Thus, it is possible to spread a load of crushed stone so evenly that it does not require any shoveling or raking, thereby saving much manual labor. Depth of the spread can be regulated by the driver from his seat.

Only when used in conjunction with other time-economizing and labor-saving machinery does the motor truck show its highest efficiency. It should not be used with slow loading and unloading methods nor be required to work on the same job with horses if it must be kept waiting from time to time for the teams to get out of the way. The crane and clam scoop, the hopper with chutes and similar quick-loading devices are enabling power vehicles to show remarkable results in the hands of large contractors. When such methods are used, the length of haul has little to do with comparative expedition and economy, because even with hauls of a mile or less the machines can be kept moving most of the time.

The Perry Sand Co., of Buffalo, which owns two Mack power dump trucks, uses the crane and clam scoop system of loading, and finds that one of the trucks does as much work as fourteen mules, and has

DUMPING BITULITHIC *paving material from White five-ton power dump truck in Cambridge, Mass., by Warren Brothers Company.*

cut delivery cost in half. (See p. 409 of May number for details and photograph.)

Other examples of the successful application of motor trucks to city work will be given in succeeding issues of MUNICIPAL ENGINEERING, together with some data showing the actual cost of operation per day and average cost of hauling a cubic yard or one ton one mile by power vehicle. There are so many facts to consider about the use of motor trucks by contractors that it is impracticable to do more in the space of a magazine article than merely to touch upon some of the more important of them in the hope that this will lead to careful personal investigation by the contractors themselves.

Motor Driven Combinations in Fire Department Service

By Samuel F. Hunter, Chief of Fire Department, Springfield, Ohio.

The city of Springfield, Ohio, not only enjoys the distinction of being the first municipality in this country to purchase a motor-driven pumping engine, but has reason to be proud of the fact that she was among the first cities in this section to realize the advantages and the savings of motor-driven combination chemical and hose wagons.

We have three of these motor-driven combinations in service and, while the financial saving over horse-drawn apparatus is considerable, the special advantage of being in a position of getting to a large number of fires in double-quick time and knocking them out before they gain headway, cannot be over estimated. The efficiency of our fire department has increased many fold since the installation of these machines, which are located in strategic positions, thus being enabled to make quick trips to the remotest parts of the city in four minutes time.

These motor-driven combination chemical and hose wagons were furnished us by the Kelly-Springfield Motor Truck Company, Springfield, Ohio. Every part of these machines is very carefully and durably made and it is my belief that the motor has fewer parts than any other 4-cylinder, 4-cycle head motor built. This motor is not only completely enclosed, including the valves, but the only moving parts exposed are the two cross-shafts in front, which drive the magneto and water circulating pump.

The magneto and water pump are driven by cross-drive in front and in connection with the French type of hood present an exceedingly neat appearance. By using an extra gear for the cross-drive the usual trouble of having too steep a spiral on the timing gear is done away with.

The equipment of our combination chemical and hose wagon includes 1,200 to 1,500 feet of 2½-inch hose, one 40- gallon chemical tank, two 3-gallon acid and soda chemical extinguishers, hose basket, 200 feet of ¾-inch hose, one nickel plated shut-off nozzle, one 20-foot extension ladder, one 12-foot roof ladder, together with the usual equipment of plaster hooks, pike poles, axes, storage battery, speedometer, lamps, lanterns, torches, nozzle plugs, etc.

The work done and the cost of operating one of these combination wagons is as follows:

For gasoline, grease and oils, per annum, $35.24.

Total mileage traveled, 417.

Total runs made, 133.

Service of Motor Apparatus

Our motor-driven combinations respond to all alarms of fire in the city on first call and are always the first apparatus to arrive at the fire. Our combinations after reporting back at the engine house are ready for another alarm of fire 20 to 30 minutes sooner than our horse-drawn equipment, which responds to the same fire reports on duty with the horses sweating and blowing and tired and many times almost exhausted, and not in a condition to respond to another and immediate alarm of fire.

I recommended that the city council sell enough bonds to purchase at least five more auto engines, to be placed at the different engine houses, and do away with almost twenty head of horses, saving the city almost $4,000 per year on maintenance cost. Also the horses get lame and sick at many times during the year, and it is necessary to keep at least two extra horses to take the place of the ones that get hurt or sick. A hurt or sick horse cannot be worked; the veterinary services cost at least $100.00 per year. We have in the department now ten head of horses that are old, and getting stiff which will have to be sold and be replaced with young horses in the near future or purchase auto apparatus. So I believe it is cheaper, and we can get quicker and better fire service to purchase auto apparatus.

Equipment in Service

There are 11,600 feet of hose in service at this time, 1 combination automobile engine, 3 combination chemical and hose wagons, 6 hose wagons, 1 aerial ladder truck, 2 service ladder trucks, 4 steam engines, 1 chief's buggy, 1 fuel wagon, 31 head of horses, all in good condition; in reserve, one 160-gallon chemical engine, 1 hose wagon, 1 buggy.

There are 600 fire hydrants in use in the city at the present time, all in good condition.

Fire Horses Are Doomed

By C. J. Lauer, Chief Columbus Fire Department, Columbus, Ohio.

Motor-driven fire apparatus received its first actual test in the city of Columbus, on October 30, 1912, when two pieces from the Twentieth street engine house went to the home of C. P. Thompson, 1314 Clifton avenue, and extinguished a $250 fire before a horse-drawn engine from the Main street house arrived. The two pieces of automobile apparatus got to the fire, half a mile distant, in two and one-half minutes after receiving the call. A day later, I made a test of the new machines on East Broad street. The machine made 20 miles in 52 minutes, including the time required for turning. On the straight-away it is estimated the machine could make from 35 to 40 miles an hour.

The city fire problem is continuous and difficult. During the year ending December 31, 1912, for example, there were 739 fires and the loss entailed was approximately $400,000. This means that every fire lost on an average a fraction over $541 and the daily fire loss averaged nearly $1,100. Fully equipped and ever ready to do battle with the Columbus fire menace, is a small army of 274 men, including a commander in chief. Thrown over the personnel of this army is a mantle of protection in the form of a civil service which applies to all members of the department in appointment, promotion and removal. The chief alone can be appointed without the civil service and at the pleasure of the mayor. His dismissal, however, is impossible except for adequate cause. Thruout the department rigid discipline prevails. Unvarying obedience to carefully drawn rules and assiduous attention to duty are absolutely required. Intoxication in the department is a crime. No member may enter a saloon or even a grocery where intoxicants are sold.

SEAGRAVE TRACTOR *for steam fire engine in speed trial by Columbus, O., fire department.*

Primary entrance into the department is shielded by fairly rigid physical and mental tests. Competitive examinations are provided. The applicant must understand and explain fairly simple propositions and must measure up to physical rules. Imperfect types are barred. The applicant must not be more than thirty-five years of age. However, the vigorous feats of strength and endurance prevailing in other cities are not compulsory. Substitute firemen are paid $2.75 for actual service. Regular firemen receive $1,100 annually, having been increased from $1,000 beginning this year. The chief of the department received $2,750 annually. The department has been costing the city approximately $330,000 per year. It will cost perhaps $30,000 more, owing both to salary increase and the installation of new engine house during the summer. All members of the department are on duty twenty-four hours each day, excepting three hours, which are given for meals. Each fifth day they receive a day off. This includes the chief. The telephone method of reporting fires is eclipsing the box system, altho boxes are still maintained everywhere thruout this city. All telephone wires are cleared to give right-of-way to the fire call.

In general equipment the department has shown a constant tendency toward the adoption of new and progressive apparatus. Motor-driven apparatus, to which the fire departments of the country generally are turning, comprises now practically one-fourth of our department. Four of the 17 houses are now fully equipped with motor-driven machines. These are headquarters house in Front street; No. 7 house in Euclid avenue, near High street; No. 8 in 20th street, near Mt. Vernon avenue, and No. 10 in West Broad street, at Glenwood avenue. Early next summer a new house is to be opened on the hilltop and only motor equipment will be placed there. Up to the present time, the motor equipment has cost $50,000 and I will soon propose a complete and almost immediate replacement of all horse-drawn apparatus. The estimated cost of the substitution is $130,000.

One of the prime tests of fire department efficiency is the promptness of response to alarms, and the main reason for the growing popularity of motor-driven equipment is its superiority in speed and lowered cost of operation over horse-drawn machines.

On February 17, 1913, speed tests were made in East Broad street, beginning at Fourth. The plan was adopted of having the horse-drawn apparatus run one mile, the motors covering the some course immediately afterwards, and applying the

SEAGRAVE MOTOR-DRIVEN *combination chemical and hose wagon, hauling horsepower steamer, Columbus, O., fire department.*

same procedure to the two and three-mile courses. A special committee followed the machine and took time records, which were as follows:

ONE MILE RUN.

Horse-drawn Apparatus:

Hose wagon No. 12..	3 min. 20	sec.
Engine No. 12.....	3 min. 38	sec.

Motor-driven:

Hose wagon No. 10..	2 min. 25 1/5	sec.
Engine No. 10.....	2 min. 40	sec.

TWO MILE RUN.

Horse-drawn Apparatus:

Hose wagon No. 11..	6 min. 10 2/5	sec.
Engine No. 8.....	7 min. 25 3/5	sec.

Motor-driven:

Combination engine with hose wagon tractor	4 min. 57	sec.

THREE MILE RUN.

Horse-drawn:

Hose wagon No. 12..	11 min. 56	sec.
Engine No. 12.....	11 min. 45	sec.

Motor-driven:

Hose wagon No. 10..	5 min. 55	sec.
Engine tractor	7 min. 00	sec.

One disadvantage under which the horses ran was the almost continuous upgrade of their course. Even barring this, however, it can be seen at a glance that while the horses fairly held their own in the short distances, they were far outclassed in the long distance runs. In the three-mile run they were badly beaten and became pitiably exhausted.

Engine companies Nos. 1, 7, 8, 9, 10 and 17 are each equipped with Seagrave tractors, each of these companies having two to three tractors, with the exception of companies 9 and 17. All of our tractors, motor-driven combination chemical and hose wagons and hook and ladder trucks were furnished us by the Seagrave Co. This company also furnished us with our motor-driven coal supply wagon. Our tractors have 6-cylinder, 80-h.p. motors. Our motor-driven combination chemical hose wagons, each carry 1,200 feet of 2½-inch cotton hose, 100 feet of 1-inch hose, 200 feet of chemical hose, one 40-gallon tank and other regulation equipment. Three of our tractors haul horse-driven hook and ladder trucks while three haul steam fire engines. Two of our motor-driven combinations also haul steam fire engines.

At this time I am recommending the installation of sufficient motor equipment to completely change our entire fire department from horse-drawn to motor-propelled apparatus. The difference in cost of maintenance in favor of motor-propelled fire apparatus justifies this change, while the increased efficiency of motor apparatus over horse-drawn apparatus would be greatly beneficial to the working of the department.

Horses are an expensive luxury and the following report of our horse department, showing the various cases of sickness, lameness and other causes that were cared for, also the number of visits made during the year ending December, 1912, is but a fair idea of inconvenience and consequent expense:

Azoturia	2
Abscesses	2
Cracked heels	2
Colds	4
Colic	3
Destroyed	2
Defective shoeing.....	2
Eye trouble	2
Floating teeth	5
Foot trouble	5
Fracture of back.....	1
Lympathic trouble	6

Nail punctures	3
Skinned and bruised	6
Strains	15
Indigestion acute	6
Blood poison	1
Kicked	1
Thumps	1
	69
Total number of visits	140

Fire Engine Tests at Milwaukee, Wisconsin

By E. A. Wilkinson, Gen. Mgr., Nott Fire Engine Co., Minneapolis, Minn.

On Tuesday, April 22, 1913, at Milwaukee, Wis., we made a demonstration with our 4-cylinder, 600-gallon machine, also our 6-cylinder, 900-gallon machine. These tests were made under the supervision of Chief Clancy, his master mechanic, and the fire committee, drafting water from a cistern and the results were as follows:

Four Cylinder Machine.

TEST NO. 1.

Two lines of 400 feet of standard fire department 2½-inch hose, each line equipped with 1⅛-inch S. B. nozzle.
Pump pressure, 160 pounds.
Nozzle pressure, 70 pounds.
Vacuum, 15 inches.
Gallons delivered, 626.

TEST NO. 2.

The same as test No. 1, siamesed into 1⅝-inch S. B. nozzle, Eastman Deluge set.
Pump pressure, 140 pounds.
Nozzle pressure, 66 pounds.
Vacuum, 16 inches.
Gallons delivered, 636.

TEST NO. 3.

One 800-foot line with 1¼-inch S. B. nozzle.
Pump pressure, 225 pounds.
Nozzle pressure, 55 pounds.
Vacuum, 10 inches.
Gallons delivered, 343.

The engine at no time on any of these tests exceeded 850 revolutions per minute. At all times you could lay your bare hand on the cylinders and leave it there on the entire test, showing the perfect control we had of our cooling system under these conditions.

Six Cylinder Machine.

TEST NO. 1.

Three lines of 300 feet of hose, each with 1¼-inch S. B. nozzle.
Pump pressure, 135 pounds.
Nozzle pressure, 65 pounds.
Vacuum, 20 inches.
Gallons delivered, 903.

TEST NO. 2.

Four 200-foot lines, siamesed into 1¾-inch deluge nozzle.
Pump pressure, 135 pounds.
Nozzle pressure, 100 pounds.
Vacuum, 20 inches.
Gallons delivered, 909.

This test was made for one hour and thirty minutes run. The last thirty minutes of the run the pump pressure was 145 pounds and the nozzle pressure was 105 pounds, delivering 932 gallons of water a minute, and we can make either of these engines deliver their rated capacity hour after hour.

Cement Production in 1912 Greatest in History

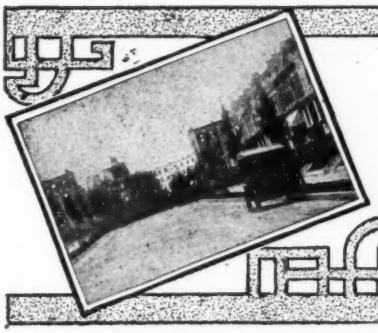
According to an advance statement by Ernest F. Burchard, of the United States Geological Survey, the total quantity of portland, natural, and puzzolan cements produced in the United States in 1912 was 83,351,191 barrels, valued at $67,461,513, compared with 79,547,958 barrels, valued at $66,705,136, in 1911. This represents an increase in quantity of 3,803,233 barrels, or 4.78 per cent., and in value of $756,377, or 1.13 per cent.

The distribution of the total production among the three main classes of cement in 1912 is as follows: portland, 82,438,096 barrels, valued at $67,016,928; natural, 821,231 barrels, valued at $367,222; puzzolan, 91,864 barrels, valued at $77,363.

The imports and exports of cement are reported to the Survey by the Bureau of Foreign and Domestic Commerce. The statements include all hydraulic cements, also the weights of sacks or barrels. Portland cement probably makes up at least 95 per cent. of the total in each year.

The imports of hydraulic cement in 1912 were approximately 68,503 barrels, valued at $93,558, or about $1.37 a barrel, compared with 164,670 barrels, valued at $252,722, or $1.47 a barrel, in 1911. This decrease in the quantity of cement imported was to be expected in view of the large excess domestic stocks that were marketed at low prices during the year.

The United States has a comparatively small export trade in cement. In 1912 the quantity exported was only 4,215,539 barrels, most of which was portland cement, valued at $6,160,341, or approximately $1.46 a barrel, compared with 3,135,409 barrels, valued at $4,632,215, or about $1.477 a barrel, in 1911. The quantity exported in 1912 was slightly more than 5 per cent. of the total production of hydraulic cements in 1912. The exports in 1910, 1911, and 1912 have shown increases of 135, 27, and 26 per cent., respectively, over those of the preceding year.

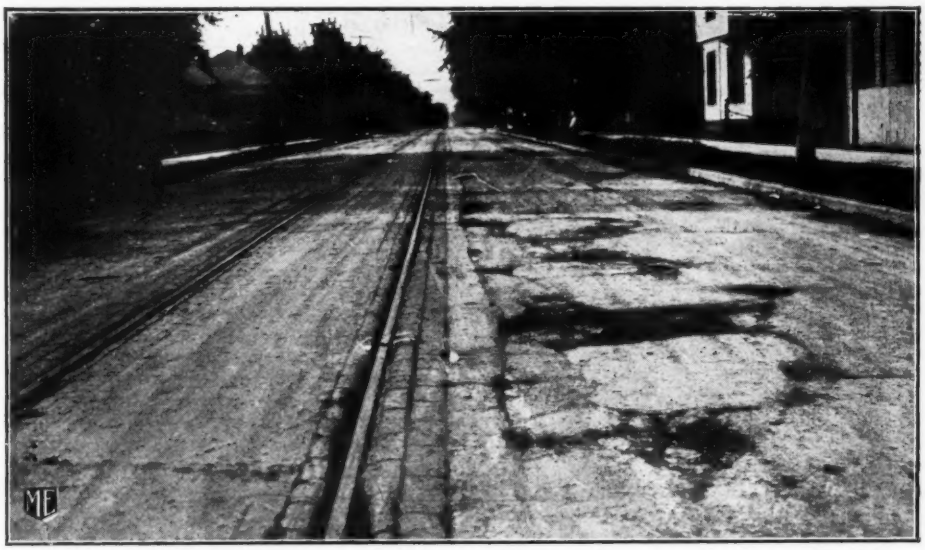


ROADS AND PAVEMENTS

Concrete Pavement Failures

By Morse-Warren Engineering Company, Carlinville, Ill.

It is the purpose of this article to show as clearly as may be the general and specific causes for the numerous failures of recently constructed concrete pavements which are witnessed on every hand thruout the United States. Probably in no line of concrete work has the number or per cent. of failures been greater than for many of the failures in pavement work, yet here we find the greatest differences of opinion among engineers. Before attempting to prepare complete specifications, an engineer should have a knowledge of the principles of pavement construction in general, and of concrete pavements in particular. A lack of proper investigation of the engineering principles has foredoomed many concrete pavements to failure. Under the head of failure due to faulty specifications, come,



CONCRETE PAVEMENT *on Wyandotte street, Windsor, Can., six years old.*

in pavements, yet a few successes, here and there, proclaim that good service can be secured. After having made a careful study of concrete pavement failures, visiting numerous cities, and in actually building concrete pavements, we feel qualified to outline the chief causes for failure in work of this class as follows:

Faulty Specifications

Under this head are found the causes

First, Unscientific Design.

This primary cause of failure is due to neglect to investigate the problem involving the forces acting upon large slabs of concrete laid upon the earth and subjected to the stresses incident to the rise and fall of the ground with every rain and drouth and with every freeze and thaw; also expansion and contraction due to the heat and cold, and the shock and jar of traffic, are to be reck-

oned with by scientific investigation. And while some of these forces cannot be ascertained with precision, they must be computed as nearly as possible.

The ignoring of the fundamental principle in the design of concrete pavements, that for any given area of slab, a certain definite thickness and strength is required to withstand the forces tending to rupture it, is a frequent cause of failure.

In this connection it may be said that a much more rational economical shape may be designed for the slab, than the uniform thickness generally required. In

CONCRETE PAVEMENT *on Toledo road out of Detroit, Mich., age 2 years.*

some cases which have been brought to our attention the slab is 20 feet in width and only 6 inches in thickness, which shows insufficient strength where no reinforcement has been used. In such cases, a proper amount of reinforcement or a reduction in the size of slab, or an increase in its thickness would have saved the failure.

Second, Neglected Foundations.

The proper drainage of the foundation is often overlooked. A trench filled with cinders or stone or gravel must be laid beneath each edge of a concrete pavement, or better and cheaper a 4-inch tile laid below the edges to a proper outlet. The foundation must be kept as dry as possible because of the swelling and heaving action of the ground below the pavement when it becomes saturated with water. Owing to capillary attraction the ground beneath the pavement is sure to be saturated from the edge toward the center several times each year, drying out between wet spells, thus rising and falling an invisible amount, but sufficient to crack the concrete if not provided for.

Third, Lack of Rolling.

The writers have seen longitudinal cracks in block after block of almost new work due to the fact that proper rolling had not been required. Observation should teach that the center of an old dirt road is very compact and that unless the sides are made of equal compactness and density, the pavement, if of light design, will be sure to crack over the center of the old road. When the slab is to be located on a newly made fill a failure to remember that the center of the fill, as generally constructed, is more compact and will settle least, has often led to disaster where the stresses involved have not been provided for by proper reinforcement or otherwise.

Fourth, Incorrect Proportions.

The proportions given the concrete govern the strength of the body and the hardness of the wearing surface. The weaker the concrete, the thicker the slab must be made to give the required strength. The relation of cost and strength should decide this matter.

The wearing surface must be the very hardest obtainable with the best stone and the richest mixture. Several partial failures have been observed due to a wearing surface of 1-2½-5 and 1-2-4. By way of illustration, showing that the harder the concrete the better the surface, a pavement of 1-2-3½ proportions laid during the past year shows some wear in six months, with a traffic of about 300 vehicles per day, while another in the same locality, with about the same service, made with top coat of 1-1-1, shows no marks of wear. It is not economical to build the entire thickness of such durable material, hence two-coat work is recommended as having a wearing surface which offers about 20 per cent. more resistance to abrasive wear at a less cost for equal strength of slab, as will be demonstrated in a future article dealing with correct methods in designing and constructing concrete pavements.

Fifth, Improper Materials.

Several pavements have been recently inspected by us which show one the surface gravel stones so soft that a pocketknife would readily cut them in parts. These pavements after three months' wear show many basins cut out by the action of the wheels. Specifications which allow stone or gravel, any parts of which are softer than neat cement mortar, are likely also to contain other defects. Soft materials are also more liable to cause failure by cracking, thru lack of tensile strength. Neglect properly to grade the materials used, to secure greatest density, is a frequent cause of weakness. Dirty sand and water has very frequently been

given as a cause of failure even in the face of many tests showing that sand can contain at least 8 per cent. of fine loam or clay without appreciable loss of strength in concrete.

A great difference exists in the strength and soundness of various brands of cement. The writers have tested brands the past year some of which show a 28-day strength test of about 600 pounds and some give up to 800 pounds tensile strength. In a concrete pavement where the hardest surface and greatest strength of body is essential, why allow an upper limit of 500 pounds when 700 pounds may be obtained? By requiring a high test for a 1:3 mixture, 28-day test, on samples submitted at once, at least 20 per cent. increase may be obtained in the hardness of the wearing surface above that frequently obtained.

Sixth, Lack of Screening.

No matter how strong, clean and well graded the stone and sand, or how strong the cement, or how rich the mixture, unless they are delivered into the mixer absolutely clean and free from foreign matter, the pavement will be sure to show pit holes and weak spots which will start raveling and wear. Neglect to screen all materials delivered which show clods of earth, coal or leaves or wood, has caused much trouble. The writers have seen defects appear in one case in less than three months after completion of the pavement, and have counted not less than two hundred holes in a distance of a thousand feet on a 16-foot roadway, and the engineer of this job has a national reputation, which illustrated the haphazard methods at present deemed sufficient in this construction by many engineers.

Seventh, Improper Mixing.

Failure to mix all batches thoroly and uniformly with the same amount of water, stone and cement will cause an unevenness in the quality of the wearing surface and lead to trouble. Each batch must be of a uniform quality so that the finished pavement will present a surface of equal durability, and thereby prevent holes and ruts. There is less chance of trouble when the mix is made of jelly like consistency, allowing a man to sink above his ankles, but yet not so wet that the water runs from the mass and leaves the stone deposited in one pile and the sand and cement elsewhere. Specifications requiring that the concrete shall be thoroly tamped into place, seem academic to those who know the better things to be obtained; yet such a clause is still often included in published specifications.

Eighth, Careless Placing of Materials.

Neglect to sprinkle the foundation before placing the wet concrete, leads often to the earth absorbing a large part of the water which should remain to harden the mix. The batch must be placed immediately, and if in two-course work the bottom course will be wet enough at the time of application of the wearing course that a man will sink to his shoe tops, the top course being of a like wetness, a perfect bond is secured and there will be one solid block of stone when set. A failure to secure this bond has caused serious trouble. Both courses are struck to the proper height by an adjustable template.

Ninth, Improper Finish of Wearing Surface.

Grooving or brooming of the wearing surface is quite unnecessary on streets with grades up to 5 per cent. They are to be considered as a source of weakness, as they expose edges of concrete to traffic. Grooves on the surface are especially

CONCRETE PAVEMENT *on Carroll Lane, Greenville, Ill., built 1910; photographed, 1912.*

objectionable as they assist abrasion to begin and also cause increased shock to the slab from heavy loads. The rough brooming sometimes practiced is subject to the same objections. Both constitute an unnecessary expense to the taxpayer and injure the work. Any disturbance of the surface after setting has begun injures its texture and allows raveling to begin.

Tenth, Faulty Joints.

In many cases, as concrete pavements are at present laid, it is doubtless true that the expansion joint is capable of lasting as long as other parts of the work, but where pavements are laid by correct methods, the expansion joint in general

use today will become the point of weakness. For our own use we have developed a joint protector that does protect. We have observed instances where the joint measured 1¾ inches in width, which is four times the required width and favors most rapid abrasion. The severity of the wheel shock increases about as the square of the joint width.

The correct spacing and location of transverse and longitudinal joints, their width, finish and protection is a subject which deserves the space of a special article.

Eleventh, Neglect of Protection.

The best concrete pavement that can be laid may be and often is absolutely ruined by not protecting it from the action of the elements when first laid. The writers have observed serious cracks appear in a pavement two hours after laying, due to exposure to a hot sun and a dry atmosphere.

As soon as built a pavement must be protected from the heat of the sun, from frost, rain and drying winds, and only after it has finally set should the surface be exposed.

Twelfth, Insufficient Curing.

Concrete sets hardest and strongest when kept well moistened. It is absolutely essential to sprinkle the surface for a period of from one to two weeks, depending on weather conditions. Neglect in this matter has ruined the quality of many jobs.

A concrete pavement requires about twenty-eight days of warm weather in which to set sufficiently to withstand the shock and wear of average traffic, and in winter months it has been ascertained that much more time is required, depending on the average temperature above freezing. Many of the failures in the surface are caused by opening the street for travel at the end of seven or ten days.

Insufficient Inspection.

The writers have known of concrete pavements being laid without an inspector on the job. Any concrete pavement work should have the constant attention of a competent inspector, selected by the engineer, whose duty shall require him to be on the job before, during and after the time the work is in progress. He should be well posted on concrete construction and capable of commanding a salary of at least $100.00 per month.

No matter how honest the contractor or how good his intentions he has the men and mixers to look after, it is his duty to place concrete, and it is next to impossible for him to watch every detail and see that forms are true to line and grade, expansion joints finished with care, clean materials used at all times, and the other provisions of the specifications exactly followed.

The engineer should prepare a complete set of specifications and provide an inspector to see that they are followed, for a contractor's guarantee of a job is always very expensive to the public.

Lack of Personal Supervision.

Many cities are exceedingly economical in their employment of engineering services, to their large financial loss. Taxpayers should realize that successful concrete pavements are not built in a day, or in a careless manner and that they require a large amount of the best engineering skill and supervision. The engineer should himself inspect and accept or reject all materials submitted for use in the work, and should personally appear on the job each day, reserving final authority in all matters to himself.

As a general rule we would expect a failure in concrete pavements when handled by, or subject to political influences and its hindrances, or when the work is attempted at a price much below the cost of other standard pavements.

Modern motor truck traffic is to be reckoned with and a careful study should be made of traffic conditions as they may exist in five or ten years.

In conclusion it may be said that neglect in any detail outlined, will certainly mean loss to the taxpayer.

Louisville (Ky.) Creosoted Wood Block

The Editor of MUNICIPAL ENGINEERING:

Sir—Answering your recent favor, will state that I have just dictated letter to H. C. Nickles, Superintendent The K. P. & C. Electric Railway Co., Kingston, Ont., which reads as follows:

"I have your inquiry regarding wood block pavements in Louisville, Ky., on streets in which car tracks are located.

"We have three streets in Louisville which were paved in 1909 with 3½-inch 20-pound creosoted wood blocks. The street railway rails are 9-inch grooved girder rails. The track construction is the best we know how to build in this city, the ties being supported on 6 inches of concrete and are entirely covered and surrounded by concrete. The foundation of the pavement proper consists of 6-inch portland cement concrete on which was placed a ½-inch mortar bed in which the blocks were set.

"These streets have been in use almost four years and have not cost one cent for repairs necessitated by ordinary wear and tear. There has been a small amount of expense incurred by the street railway company on account of some damage done to the pavement by loose rail joints.

This trouble, however, has been comparatively small and confined to one of the three streets, the other two have given no trouble whatever. I do not attribute any of this trouble to the fact that the street is paved with wood block as you know as well as I that loose joints will destroy any kind of pavement.

"We have another street in this city which was paved with wood block in 1911. The tracks in this street and the wood block pavement were constructed exactly as described above and to date there has been no expense attached to this pavement for any cause.

"My personal opinion is that first class creosoted wood block pavement is the most satisfactory pavement now being laid when considered from all points. I would not hesitate to put wood block on a street where the traffic was medium or heavy regardless of whether the street contained car tracks or not. This opinion, however, is based on the supposition of grooved girder rails being used. I have had no experience with wood block on other rail sections and consequently would not venture to express an opinion as to its durability under such conditions.

"We have experienced no trouble whatever on account of expansion in creocoted wood blocks."

The three streets mentioned in above letter were, Fifth from Market to Jefferson, 1,700.6 square yards, Sixth, Market to Jefferson, 1,798.5 square yards; and Jefferson from Sixth to Seventh, 3,852.7 square yards. These were the first creosoted wood block streets laid in Louisville and are now almost four years old. The specifications call for Southern long-leaf yellow pine not less than 90 per cent. heart and the treatment with 20 pounds of oil. The oil was a straight coal tar product of about 1.12 gravity.

For the first two summers after these streets were paved considerable trouble was experienced from bleeding which I attribute to the specific gravity of the oil used. All three of these streets carry heavy traffic and have cost nothing for maintenance outside of the trouble mentioned in the above letter due to loose rail joints. In fact the streets improve with use, as under the traffic the surface becomes smooth and the joints almost invisible. These pavements to date are in much better condition on the quarters and center than they are near the gutters, where standing vehicles prevent the traffic reaching the surface. Alter the second summer the bleeding ceased entirely and there has been no further trouble from this source.

In 1911, Fourth street from Walnut to Jefferson, 4,756.9 square yards, was paved with creosoted wood blocks under the same specifications mentioned above except that the gravity of the oil was reduced to 1.10 but in other respects the conditions are exactly the same as those on Fifth, Sixth and Jefferson streets. This pavement has now passed thru its first summer without any signs of bleeding whatever. This street also contains double car tracks constructed as above and as the roadway is only 38 feet wide practically all of the traffic occupies the car tracks. Altho only a little over one year old the joints, where the traffic reaches the pavement, have become practically invisible. In all of these streets sand filler only was used in the joints, except where there was an opportunity for unusual vibration over track crossings, frogs and switch points; at such intersections asphalt filler was used.

We now have under contract about 2,500 square yards of creosoted wood block upon streets in which the conditions are similar to those mentioned above. One of the streets under contract, Main street, will carry as heavy loads as any street in the city, and I anticipate no trouble from this source as I believe creosoted wood block pavement to be more satisfactory under heavy traffic than under light. The pavement seems to require considerable traffic to keep it in proper condition. The pavement under contract is the same as has been built heretofore with the exception that 16 pounds of oil to the cubic foot will be used instead of 20 pounds. This change is in line with what appears to be the general practice thruout the country at the present time and I believe will furnish a pavement equally as satisfactory as one with 20 pounds of oil, and a certain saving in the initial cost.

All things considered it is my opinion that yellow pine creosoted block pavement is the most satisfactory now being laid. It is without question sanitary, noiseless, dustless and durable and costs very little for maintenance. Its appearance is also very pleasing. The only objection which we have experienced is that it is slippery in wet weather. Our experience has shown that it is very easy and economical to repair defects or openings in the street in such manner that they are hardly perceptible after repairing.

I do not know of any difference between the specifications in use in Louisville and other cities except that heretofore we have specified not less than 90 per cent heart. In the future, for economy, this will be changed to "square edges and sound."

To summarize our local experience I would say that creosoted wood block has proven very satisfactory in Louisville and has less objections to it than any other class of pavement with which we have had experience. The comparatively small area of this pavement laid heretofore is

due to an abundance of caution which prompted us to feel our way gradually in the use and merits of this class of pavement. However, the results are so highly satisfactory that I trust the yardage will be very materially increased in future years.

D. R. LYMAN,
Chief Engineer, Department of Engineering, Louisville, Ky.

Paving in Chicago

The Editor of MUNICIPAL ENGINEERING:

Sir—The average cost of asphalt repairs for the season of 1911 was $1.085 per square yard. This is $0.084 less, per square yard, than our low cost of 1910. Our total cost of maintenance per square yard of $0.057 is lower by $0.011 than our low cost of 1910. This compares very favorably with the cost of asphalt repairs in various other large cities in the United States.

It is the policy of the administration to perform all work, wherever possible, by day labor.

Practically all of the brick streets out of reserve have been put in good condition and 1911 was the first year that an attempt has been made to repair all our brick streets. The most important item in connection with brick repairs has been the most complete rehabilitation of brick pavements in subways.

On account of the large amount of old granite block that has been replaced by creosote block in the Loop district, the cost of granite repairs was reduced from $39,323 in 1910 to $19,780.99 in 1911. The average cost of repairs in 1911 was $0.637, as compared with $0.598 in 1910. This increase in cost is due to the fact that smaller areas were repaired and consequently the repair forces were shifted about more frequently. This, as is well known, increases the cost per square yard.

Macadam pavements are in constant need of repair and attention. There were approximately 460 miles of this class of pavement out of reserve on December 31, 1911, and under jurisdiction of this bureau, and altho we are spending larger sums of money each year on these streets, the entire wheel tax fund is not sufficient to put all macadam streets in first-class condition and to meet the demands of property owners and various improvement associations.

In order to secure more permanent results on macadam streets with heavy traffic, repairs were made by using a course of two or three inches of crushed granite chips rolled in. Altho the initial cost is greater than the usual macadam repair, results obtained would indicate that the repairs will last much longer and thereby reduce the maintenance cost, extended over a period of three or more years.

All street repair work was done by day labor with the exception of the repair of asphalt pavements.

Previous to 1911 an emulsion of soap, oil and water was used with fairly good results. With an emulsion a macadam street must be gone over every two or three weeks and with our large mileage of macadam pavements it was impossible to keep the dust down. With the use of straight oil, however, one application a season is sufficient and we are able to cover the entire area of macadam streets. We find the use of oil more satisfactory, as it has proven to be a good binder and not only acts as a dust preventive, but as a good road preserver.

We have improved on our methods of applying oil by the use of portable boilers, equipped with pumps, which enable us to heat the oil in the tank cars; pump directly into our distributing wagons and apply the oil hot to the pavement, instead of cold. This results in a better penetration, thus doing away with an excess amount of oil on the surface, which previous to this method of application was the source of numerous complaints.

During the past two years many improved machines have been patented which insure a better distribution of the oil and it is the intention of the bureau to experiment with several of these devices, as they can be attached to our present sprinklers at very little expense.

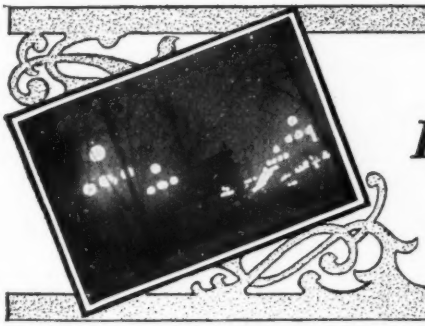
Total number of square yards of macadam pavement oiled in 1911, 6,019,941; total cost, $86,504.62; average cost per square yard, $0.0143.

Pavement, cement walks, combined curb and gutter, concrete curb and concrete gutter constructed under the supervision of the permit division of the city of Chicago during the year ending December 31, 1911:

Pavement

Granite block	561,495 sq. yds.
Brick	137,219 sq. yds.
Asphalt	66,361 sq. yds.
Creosoted block	38,618 sq. yds.
Cedar block	28,791 sq. yds.
Macadam	19,368 sq. yds.
Planks	967 sq. yds.
Concrete	212 sq. yds.
Slag	6 sq. yds.
Total	852,837 sq. yds.
Cement walks	371,041 sq. ft.
Combined curb and gutter	30,687 lin. ft.
Concrete curb	11,924 lin. ft.
Concrete gutter	547 lin. ft.

F. W. SOLEN,
Superintendent of Streets, Chicago, Ill.



FIRE AND WATER

Efficient Handling of Lime and Chemicals at the Columbus (O.) Water Softening and Purification Works

By Charles B. Hoover, Chemist in Charge.

Our very successful experience with the Jeffrey apron conveyor installed at the time of construction of our plant, has induced us to make another very similar installation. This conveyor has been used from the very first as a carrier of chemicals to the third floor of the head house where the solutions are made up. This conveyor, which is in the center of the storage house, and which extends nearly its full length, is driven by an 18-h.p. enclosed motor with a maximum carrying capacity of twelve bags per minute when running at a speed of 50 feet per minute.

At the time the water purification plant was put in operation, all of the chemicals to be used in softening and purifying the water, were handled and stored in canvas bags. The original chemical house consists of one large room, 59 feet 8 inches wide and 105 feet long, and has an estimated capacity of 900 tons.

The first consignment of lime, consisting of several hundred tons, was delivered in bags, each containing a net weight of 100 pounds. The bagged material was stored in the chemical store house, but before it could be used, it was air slaked and almost all of the bags burst, demonstrating conclusively the inadvisability of storing lime in bags. Further trouble was also experienced, while using lime delivered in bags, in maintaining a uniform application of the chemical to the water and it was found that the bags of lime varied in weight from 10 to 15 pounds per bag.

After this experience of storing sacked lime, it was decided to buy lime delivered in box cars, loaded in bulk. A reserve stock of lime amounting to about 60 tons was stored in steel drums provided with 8-inch screw tops. Arrangements were also made with the lime contractor whereby he was to ship the lime at a uniform rate of not less than 40 nor more than 125 tons per week as directed by the chemist in charge. The lime, as soon as received, was sacked, 90 pounds to a sack, by the workmen at the purification works, and it was planned to regulate the lime shipments so that the lime could be used as soon as received.

The amount of lime necessary to soften the water changes from day to day and during flood times or after heavy rains the hardness of the river water drops from 300 to 400 parts per million to 100 or 150 parts per million and these changes sometimes occur in less than four hours' time, consequently there were often six or seven cars of lime on the siding at the plant or in transit, in excess of that which could be consumed. Some of these cars were held as long as two weeks before being unloaded, because there was no available place to store the excess material. This condition of affairs resulted in a loss to the city, first because of the demurrage on cars, and secondly because the lime air slaked and lost strength. The cost of sacking and weighing the lime was high. It required five men working nine hours to sack and weigh a car of lime containing 20 tons and after the lime was sacked, it took 1½ to 2 hours to elevate the lime to the third floor of the head house, where it was again lifted by hand to the lime slakers. The cost of handling lime by this tedious process amounted to approximately $1.00 per ton. The work of sacking lime from cars proved to be a very disagreeable job, especially in hot weather, on account of the lime dust slaking on the sweaty hands and faces of the men. This slaking of the lime dust often resulted in severe burns and sores. It was thought that the disagreeable features attending the use of quick lime might be overcome by using hydrated lime in its place. Several carload lots of hydrated lime packed in 40-pound valve-type paper bags were received and used. This material was eas-

ily stored because the bags were square and could be closely packed, and as the lime had already had its affinity for water satisfied there was no trouble from swelling and bursting of bags. The material could be kept indefinitely without losing strength because it packs into a dense mass, rendering the penetration of carbon dioxide very difficult. However, it did not prove economical or satisfactory to handle and its use was abandoned.

The storage capacity for lime having become inadequate and the method of handling being unsatisfactory, the Superintendent of Water Works, Mr. Jerry O'Shaughnessy, authorized the writer to prepare plans and estimates for new equipment for handling lime. The equipment is similar to the installation in use at the coagulating plant of the St. Louis water works and consists essentially of a concrete bin, elevated on columns over the railroad tracks located between the head house of the water purification works and the sedimentation basins; a Jeffrey V-bucket conveyor and elevator for elevating the lime to the level of the head house roof; a screw conveyor for conveying it across and into the head house where it is dropped into tanks; and three scales for automatically weighing and dumping the lime into the old slaking tanks below. The storage bin consists of a concrete hopper, 25½ feet square, with bottom slopes of approximately 38 degrees with the horizontal, heavily reinforced to take the direct pull due to the weight of the lime and the horizontal thrust due to the bulging effect. The main weight is carried on four reinforced concrete beams, which are in turn supported by eight columns with flared footings, which take bearings on the solid gravel under the track bed. The storage bin has a capacity of 220 tons of lime or about 22 days supply, which gives ample storage for any emergency. The bin is rectangular in shape with the bottob hoppered four ways to a hollow center column. A small hopper with three inch mesh grating was arranged under the bin between the railway tracks above the ground line and extending up to about on a level with a car floor. A power shovel (such as is used for unloading grain from cars) was provided for handling the lime from cars on either track to this steel hopper. The shovel machinery and its driving motor were located on a steel frame up under the bin bottom and directly over the steel hopper. From the steel hopper the material is delivered by a short spiral conveyor feeder into a run-around V-bucket conveyor. This latter passes thru a pit below the ground level, parallel with the railway tracks, under the small hopper and spiral conveyor feeder, then up one side of the bin across the top, and down the opposite side of the bin. The conveyor trough across the top of the bin is arranged so that material can be delivered directly to the bin for storage or to a spiral conveyor leading off at right angles with the bucket conveyor and delivering to tanks in the slaking room of the head house.

The lime is reclaimed from storage by drawing it out thru the hollow center column and thru a steel chute extending from the column to the steel hopper, into which the material was at first shoveled from the car. The flow of material from the bin is regulated by means of a chop gate which is located in the steel chute just outside the hollow column and which is operated by hand. From the hopper the material is fed to the V-bucket conveyor and again carried to the top of the bin. This time, however, it is delivered to the cross spiral conveyor, which in turn delivers it to either of the three steel tanks located in the head house, one over each slaking tank, and which are supported by steel frames from the slaking room floor. These bins, which are of approximately ten tons capacity each, are filled every day, or oftener if necessary, so as to keep a small supply close at hand to feed the slaking tanks. From these bins the lime is delivered to automatic weighing scales which are located close up under the bins and which are arranged to automatically weigh out the lime in lots of one hundred pounds or less and dump it into the slaking tanks at regular intervals as desired. The connection between the bins and the scales is by means of short closely fitting telescoping chutes so that no strain can be thrown upon the scales by the tanks. These chutes are provided with rack and pinion valves to shut off the flow of material to the scales if desired.

From the above it will be noted that the only labor necessary for handling the lime when it is being delivered to storage is a man to operate the power shovel. When filling the small tanks in the head house, one man can regulate the chop gate in the chute from storage bin and also attend to the valves in the conveyor over each tank to see that they are closed when the tank is filled and the next valve opened. The attendant who has charge of the preparation of the other chemicals in the slaking room can also look after the automatic scales and the slaking of the lime.

The conveying machinery, steel tanks, roof trusses and ceiling for bin, which were installed by The Jeffrey Manufacturing Company, are of their standard quality in workmanship and design and are of such heavy construction that the depreciation on them will be very small.

All chutes and tanks are of ¼-inch thick steel plate and are made as near dust tight as possible. The spiral conveyors are 12 inches in diameter, or 3/16-inch thick steel flights and carried in 3/16-inch thick steel troughs. The bucket conveyor is made up of 18 by 16 by 8 inch V-shaped steel buckets spaced every 2 feet on two strands of 12-inch pitch steel-thimble roller chain. The chain is made up of 2½ by 5/16 inch steel side-bars, ¾-inch diameter pins, case-hardened steel bushings and 5-inch diameter rollers. The spiral feeder is driven at 35 r.p.m. thru a pair of miter gears with a chain and sprockets from the lower corner shaft of the up-going strand of the bucket conveyor. The bucket conveyor is driven by a belt-connected 18-h.p. motor thru a set of spur gears with two countershafts at 100 feet per minute. The cross conveyor is driven by a chain and clutched sprocket from the first countershaft of the bucket conveyor at 86 r.p.m., and can be thrown out of service when material is being delivered to storage. The motor is located up under the roof of the storage bin at one side of the bucket conveyor upon a steel frame which is supported from the roof trusses at one end and from the bucket conveyor frame at the other end. The bucket conveyor is carried across the top of the storage bin by a structural steel frame which spans the bin from wall to wall just above the bottom chord of the roof trusses, and which also carries all of the driving machinery. The bin is closed in at the top by a steel plate ceiling attached to 3-inch beams which are framed into the bottom chords of the roof trusses. Access to the interior of the bin is gained by means of a manhole in the ceiling plates.

The old method of handling the lime before the above installation was made, was to shovel the lime into cloth sacks in the car, weigh and tie 100 pounds in each sack, then carry the sacks into the building and place them on an inclined apron conveyor which extends up into the slaking room and discharges the sacks upon the floor. The available space in the slaking room for storage was very limited and only a few sacks could be carried up at a time, consequently, most of the lime was stored on the ground floor. This meant labor for double handling. It was also a difficult matter to secure labor for handling the lime in this old way, especially in summer, due to the fact that the lime could not be handled without raising a great deal of dust with attendant unpleasant results from inhaling it, getting it into the eyes, or receiving it on exposed surfaces of the body when moist with perspiration. With the new method of handling the lime, the only person who comes in contact with the dust sufficiently to be affected very badly will be the shovel operator in the car. However, even he is not affected as much as under the old system, in that a can be unloaded much more quickly than before so that he is not exposed to the dust very long at a time.

The labor of simply unloading the lime from the cars by the old method required on an average five men for nine hours each per car of twenty tons. This at the municipal scale of $2.25 per day of eight hours, amounted to approximately $12.65 per car or 63 cents per ton. With the new method, it requires the services of one man for approximately three hours to unload a 40-ton car at a cost of about 85 cents or 2 cents per ton. Using the amount of lime consumed last year as a basis, the superintendent of the plant estimates that he can save $3,300 this year on operating expense due to the increased facility of handling the lime. The city of Columbus is growing in population very rapidly so that more water is required each year to supply its needs, consequently, more chemicals will be needed each year to keep the purity of the water delivered to the city up to the the standard already established. As a result, the amount saved in the cost of handling the lime as compared with what it would be under the old methods employed, will be greater each year as time goes on. The total cost of installation including storage bin, power shovel, conveyors, tanks and scales was approximately $18,000.00. This year's estimate of saving means a return of 18 1/3 per cent. on the investment. In addition to this, the work is accomplished with much great ease and less worry on the part of the operators about securing the necessary labor and as to whether they have a sufficient amount of lime on hand at all times to tide them over any emergency.

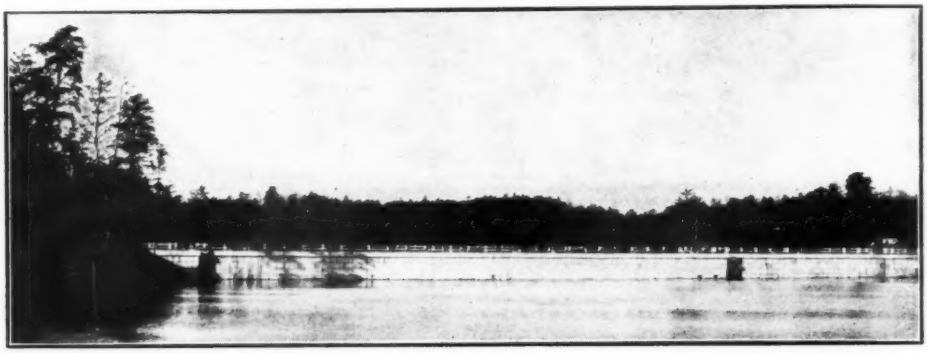
The above will give the reader only a small idea of the possibilities of "conservation of energy," low costs of handling materials, as well as the increased quality of the completed product, which present themselves to the engineers and manufacturers who are interested in handling the general elevating and conveying machinery problems.

A Model Water Supply for Manufacturing Purposes.

IT is not often that a manufacturing corporation finds it necessary to develop a water supply as large as a large city would require and at the same time desirable to safeguard it from pollution. The Tennessee Coal, Iron and Railroad Company of Birmingham, Ala., which company is a subsidiary of the

United States Steel Corporation, has recently completed the works to furnish such a supply. The requirements of the ordinary municipal supply have been so fully met that a description of the plant will be of interest to the municipal official from every point of view.

Birmingham is supplied with filtered water obtained at considerable expense and not unlimited in quantity without still greater expense, and such industrial plants as the steel works have found it necessary to furnish their own supplies. In this case the supply need not be filtered, but, with this exception the supply is quite as carefully guarded as is usual for domestic supplies.



RESERVOIR DAM AND SPILLWAY *for water supply of*

The minimum supply to be provided was fixed at 25,000,000 gallons a day. A thorough study of all the available sources of supply was made by Morris Knowles, consulting engineer, taking ten months. Areas of watersheds, rainfalls at many stations on the watersheds, runoffs, sanitary conditions, were all studied in detail. The collection of rainfall and runoff data, secured in part with the cooperation of the U. S. Geological Survey, is perhaps the most complete which has been made for a like area.

Village Creek, from which a partial supply has been pumped for several years, was selected as the supply to be developed. The minimum flow of this creek is not more than 1,500,000 gallons a day. A reservoir to retain flood waters is therefore necessary. This reservoir is produced by putting a dam across Village Creek just above the mouth of Venison branch, which is about 6.5 miles from the Ensley plant. This dam was built 90 feet high and is designed so that its height can be increased 15 feet whenever required. The spillway is 10 feet lower, so that the full reservoir has a depth of 80 feet at the dam. One of the accompanying photographs shows in two cuts a panoramic view of the dam from the upper side, the rock ridge against which it abuts on the right and thru which the spillway is cut to discharge into Venison branch, the spillway itself with bridge over it, and the continuation of the ridge to the right.

A concrete lip for the overflow of the spillway was constructed and defines the flow line of the reservoir. In the view some of the solid rock shows beyond the concrete lip, not having been taken down accurately to its level. A bridge is seen spanning the spillway.

Village Creek runs away from Ensley and the water from the reservoir must be pumped to a high-level reservoir for distribution to the plants at Ensley and Corey. A coal mine with a steam power plant is located at Edgewater, between the two reservoirs and the pumping plant is located there. The intake from the Village Creek reservoir is in Camp branch, an arm of the reservoir and is 40 feet below the level of the full reservoir, so that this marks the available reservoir capacity. However, the storage capacity above the intake is over 2,000 million gallons, while that below is only 500 million gallons, so that 80 per cent. of the reservoir capacity is available. The present draft of water is about 28,000,000 gallons a day.

When 15 feet more height provided for is added to the dam and the lip of the spillway is raised by the same amount, the capacity of the reservoir will be more than doubled, as it will be 4,700 million gallons and the supply can then be depended upon to furnish 50 million gallons a day.

The location of the intake requires the cutting of a channel in Camp branch about 3,000 feet long. This channel and the tunnel, 8,280 feet long, from the intake to the pumping plant are large enough to supply 75 million gallons a day, by gravity, the fall being 0.61 foot per

thousand and the cross-section of horseshoe shape about 6 feet 3 inches high by 5 feet 6 inches wide. This tunnel is shown in one of the accompanying photographs.

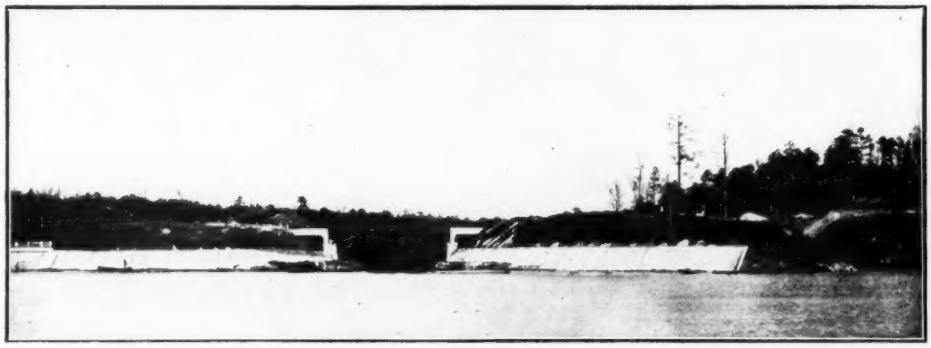
Besides the 28,000,000 gallons a day taken from this reservoir, the steel plants use 6,000,000 gallons from other sources. Much of this water is used for cooling purposes and from 60 to 70 per cent. of it is run back into the reservoir to be used again. That used in the Semet-Solvay process works is too much polluted to be used again and is discharged thru a cast iron pipe about 7 miles long and 6 and 8 inches diameter into Village Creek below the dam. Experiments are being made on settling and filtering water from coal washers and on purification of sewage from Birmingham which enters the creek above the reservoir, so as to reduce pollution in the latter case and increase the amount of water that can be returned to the reservoir in the other.

The reservoir in its present condition covers 320 acres and is long, narrow and deep with two branches. The half of the total discharge which it does not hold may discharge over the spillway several feet deep. The dam provides for a depth of overflow of 10 feet. To show the care taken of the sanitary features it may be mentioned that trees and brush are removed from the banks of the reservoir for the space that would be covered by a rise in the water of 5 feet, thus providing that no ordinary fluctuation in water level will kill vegetation and produce objectionable conditions anywhere about the reservoir. The area of this strip is 70 acres. The whole bottom of the reservoir was cleaned and grubbed before it was filled, just as though it were to be used for domestic purposes. The possibility of stagnant pools where mosquito larvae might develop undisturbed by wind or current was also considered, and the observations that have been made with respect to the conditions of the reservoir in this regard have been close and accurate enough to serve as a successful defense in a suit in which one of the claims was the increase in number of mosquitoes since the construction of the reservoir. Analyses to show the condition of the water and the changes taking place in it on account of the construction of the reservoir and with the changes in the seasons were made once a week for the first year and are now made monthly.

When the maximum of 50,000,000 gallons a day is developed from Village Creek, if there should be need for further supply it can be developed by building a dam in Venison branch below the spillway from the Village Creek reservoir to hold the small amount available from that branch and the overflow from the Village Creek reservoir, the spillway being cut down to give free flow in either direction between the two reservoirs.

Observations of the evaporation from the surface of the reservoir are taken regularly. Three standard evaporation pans are located not far from midway of the length of the reservoir. Each pan is located on a float with a raingage and a recording anemometer so that the observations can be properly corrected. One float is located in the middle of the reservoir and one at each side. One of the accompanying photographs shows the general nature of the reservoir and the shores, showing the clearing near the water line and the rugged wooded steep slopes which are characteristic of the whole reservoir.

The photograph also shows a bridge across the reservoir for the railroad line used for hauling in construction material. Part of this railroad was already in existence for handling coal from mines in the vicinity. It was extended 1.6 miles to reach the dam site.



Tennessee Coal, Iron and Railroad Co., Birmingham, Ala.

RESERVOIR, *showing width, cleared shores, and bridge of railroad used to supply materials for construction of dam.*

The care with which each detail is worked out is again illustrated by the fact that the plans and methods for the development of the mines whose workings pass under the reservoir or which might affect it in any way must meet the approval of the chief engineer of the water department and are under his continual inspection.

The general form of cross-section and the method of construction of the dam are shown quite well by the photograph of the dam under construction. It was designed by standard methods and the additional 15 feet called for by the design can be added whenever desired.

The stone for the cyclopean masonry of which the dam is composed was quarried from the adjoining hills, much of it from the cut made for the spillway, and from the foundation. The general size and character of stones and the methods of handling after they reached the dam can be judged from the photograph. After careful test it was decided to use crushed slag for concrete,

The storage for slag, sand and cement, the stone crushers and concrete mixers were located on the right of the spillway as seen in the panoramic view, and the mixed concrete was run in cars over the bridge. Two cables spanned the gorge. One over the center of the dam had movable supports so that it could serve the up-stream part of the dam directly, the other was fixed over the lower side. Experience seems to have shown that the fixed cable should have been located over the up-stream face of the dam, which was nearly vertical, and the movable cable way should have covered the lower side with its greater slopes and consequent necessity for more flexible service. The derricks and cranes for secondary service are seen in the photograph.

The proportions of concrete used in the dam generally were 1 cement, 2½ sand, 5 slag at first and later 1:3:6. About 22 per cent. of the interior of the dam was composed of the large stones, deposited in the concrete as shown in the photograph.

The dam was faced, above and below, with concrete blocks, as being most satisfactory in appearance, ease of construction and cost. They were molded of the forms and dimensions needed for all situations and special demands. Thus the pilasters shown on the face of the dam are fitted exactly to their duties at a minimum of cost. These pilasters are located at four of the expansion joints with which the dam is provided, each joint extending entirely thru the dam from top to bottom. Expansion joints are located also at the abutments of the dam. The face blocks at each expansion joint were so cast as to give a hexagonal drainage channel just inside the downstream face to collect any seepage thru the joints and discharge it into a 6-inch vitrified pipe along the toe of the dam which, in turn, discharges into the creek below. The concrete coping blocks and the concrete posts and railing can be seen, tho small, in the panoramic view. The rails and posts are reinforced with four 5/16-inch rods and cost only 60 cents per foot of railing, including the posts.

The concrete blocks were made of 1 part cement, 2 sand, and 4 slag. The yard in which they were made was a level place near the storage, readily accessible to the mixers which delivered the concrete on cars the same as to the dam. The whole yard was covered by a revolving crane, so that forms, concrete, and finished blocks could be handled with a minimum of expense. The sheet metal form for the face has made a smooth surface and great care was taken to prevent honeycombing on it.

The first construction on the dam was the cut-off wall, which extended 20 feet below the bed rock on which the dam

TUNNEL *from reservoir to pumping station, concrete lining.*

rested. This wall was 8 feet wide at the bottom and 8 to 20 feet on top on account of variations in the quality of the rock. Several springs were found in fissures in the rock. Each of these was boxed in with a well calked wooden box from which a 2-inch iron pipe was carried up beyond the point to which the water from the spring would rise, the concrete being placed about these pipes, which were extended as the dam increased in height. While excavation was going on the water was pumped out, but while concreting was in progress the water was not disturbed. Permanganate of potash was pumped in the twenty pipes from the fissure springs to see whether it would appear anywhere on the surrounding surface, without result. Pumping water into the pipes at 60 pounds pressure showed that eight pipes were tight and twelve permitted water to pass. Into these twelve cement grout was pumped under 25 pounds pressure. When a leak developed, some of them as much as 75 feet from the dam, pumping was stopped until next day, and was then resumed at a higher pressure. After one to four applications of pressure, the last at 60 pounds, the pipes were found to be tight. Nearly 1,200 barrels of cement were used in this grout.

The base of the dam was 10 to 11 feet below the previously existing bed of the creek. It will be seen from the photograph that the dam was constructed in alternate sections and the expansion joints were constructed at the junctions of these sections. In the photograph will be seen three of the five vertical tiers of concrete header blocks which were set in the faces of the sections first constructed, to prevent the direct flow of water thru the joints. The whole face of the section was thoroly coated with coal tar before the following section was placed. Ordinary paving pitch was selected for this coating after a series of experiments to test the adhesion and brittleness of various compounds proposed. There is a very slight seepage of water thru the dam, which is attributed to the use of slag. It is too slight to be considered.

DAM *under construction. Note cyclopean masonry with concrete block facing, expansion joints, well for gate chamber, block storage and derricks for handling material delivered by cables from above.*

The large stone used in the dam cost $1.34 a cubic yard delivered at the dam. The concrete was placed at $3.11 a cubic yard and the concrete blocks cost $4.56 a cubic yard. Set in place the blocks cost

$6.72 a cubic yard, the coping blocks $9.66 and the railing $12.62.

In addition to the spillway, which is shown in one of the photographs and is ample for the 7 feet of water which it is expected may pass the 450-foot lip of the overflow, there are gates in the dam which can be opened as desired. Two of these gates are at the bottom of the dam, each being a 30 by 60 inch sluice gate. From the bottom of each well into which they open runs a 48-inch cast iron pipe thru the dam, with a 36-inch valve at the other toe. Cranks, racks and pinions operate the gates. Two similar gates are located 40 feet above the bottom of the wall. During construction of the dam one additional 72-inch pipe was in operation, the three pipes carrying the flow of the stream until the dam was completed, when the 72-inch pipe was filled with concrete. Stop planks can be used above the sluice gates in case they stick or are broken.

A recording water gage in the valve shaft keeps record of height of water and opening of gates is recorded so that discharge of water from the reservoir by way of gates and overflow can be estimated with reasonable accuracy.

Two 12,000,000-gallon Allis pumps have been installed and others are provided

OVERFLOW CHANNEL *from spillway and bridge used during construction for transfer of materials. Stone for cyclopean masonry was quarried from this excavation.*

for to be installed as needed, up to the conduit capacity of 75,000,000 gallons a day. These pumps force the water thru a 50-inch lock bar riveted steel pipe, 8,904 feet long, which connects with the distributing mains and also with the high-level reservoir, shown in one of the photographs, and which thus serves as an equalizer. This reservoir holds 17,000,000 gallons, is rectangular with rounded corners, 439 by 353 feet gross measurement, 20 feet depth of water and 25 feet height of sides, and was constructed partly in excavation and partly in embankment. The concrete lining, 6 inches thick, covers the bottom and the sides to elevation 3 feet above flow line. The mixture is 1:2.5:5 and alternate 10-feet-square blocks

HIGH LEVEL RESERVOIR, *partly in excavation and partly in embankment, serving as distribution or equalizing reservoir.*

were laid with expansion joints all round, filled with tar and concreted over.

H. M. Urban was chief engineer in design and construction; Morris Knowles, consulting engineer; William F. Wilcox was principal assistant during construction and is now superintendent in charge of the operation of the whole system. O. G. Thurlow had charge of designs and drafting; Hugh G. Stokes, of the construction of the reservoir and pumping station and their connections and appurtenances, and Eugene Underwood of the high level reservoir and main and distribution pipes.

Water Works of Daytona, Fla.

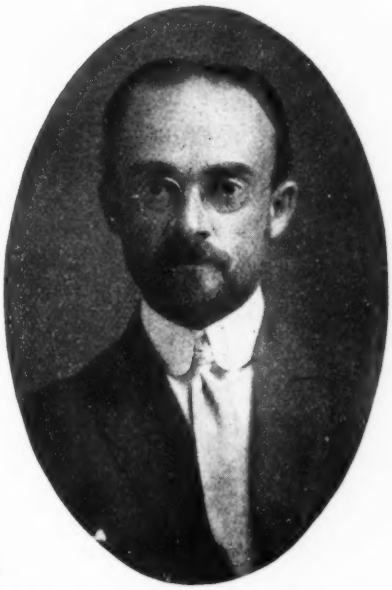
By Geo. A. Main, M. E., Superintendent.

No two water works managers have identical problems. Each meets his own particular problems, solves them more or less satisfactorily, and seldom takes the time to consider the fact that in some respects they are different from those of any other manager, and that for this reason a birds-eye view of his plant would be of interest to the managers of other water works. He forgets his own indebtedness to those from whom he has learned either by visits to other plants or by reading of them in some of the many good periodicals devoted to water works matters. The writer wishes to acknowledge his indebtedness to those with whom he has come in contact either thru their articles or personally, and with this as his apology offers the following description of the water works with which he has been associated since its construction in 1909.

Were it not for the need of fire pro-

tection before this plant was built this city might still have had no water works. Water for domestic purposes was too easily procured to make it probable that the city would bond for a plant for that purpose. In fact, practically every residence in the city was already provided with this available water supply.

Artesian wells with ample head to operate a small ram, which in turn with almost no attention would maintain an abundant supply of the artesian water in the elevated tank provided for the purpose, were procurable at small cost. To be sure this artesian water was quite hard, but most of these residences were also equipped with rain water cisterns



GEO. A. MAIN, M. E., *superintendent of waterworks, Daytona, Fla.*

capacious enough to meet the requirements for bath and laundry purposes, and had they not been so provided there was no intimation that a municipal plant would give them soft water.

It seemed obvious, therefore, that a municipal water works would be of use, chiefly at least, for fire protection.

In the fall of 1908 this city, by a very small majority, voted bonds to the amount of fifty thousand dollars for the construction of the contemplated system, and engaged Mr. Clarence M. Rogers, of the firm of D. D. and C. M. Rogers, civil engineers, of this city, to superintend the design and construction of the proposed system. The work was begun early in 1909 and the first tap was made in September of the same year. The requirements of the underwriters of course determined the size of the plant.

Like the hundreds of miniature water works then existing and some of which are still to be found in operation, the source of supply of the municipal plant was to be artesian wells. Four 6-inch wells ranging in depth from 170 to 250 feet and having a combined flow of about 1,600 gallons per minute at the ground level supply the raw water. These wells have a static head of about 12 feet above the ground. The raw water therefore flows by its own pressure into the three 60,000-gallon reservoirs in which it is treated for the removal of such foreign materials as aeration and the Porter-Clarke process will remove. The first of these impurities to be noticed is the ill smelling hydrogen sulphide gas (H_2S) with which these flowing waters are thoroly impregnated. And this is the first impurity removed.

The raw water enters these reservoirs as a fountain, shaped like an inverted cone. The aeration it receives in passing thru the air and in its subsequent splatter on the float in the center of which the fountain is placed, completely removes the hydrogen sulphide gas, after which the water falls into the reservoir. The raw water as it comes from the wells is clear and sparkling. Exposure to the light, however, results in a rapid growth of algae and by the time the reservoirs are full, which requires about three or four hours, the water is very dark colored, almost black.

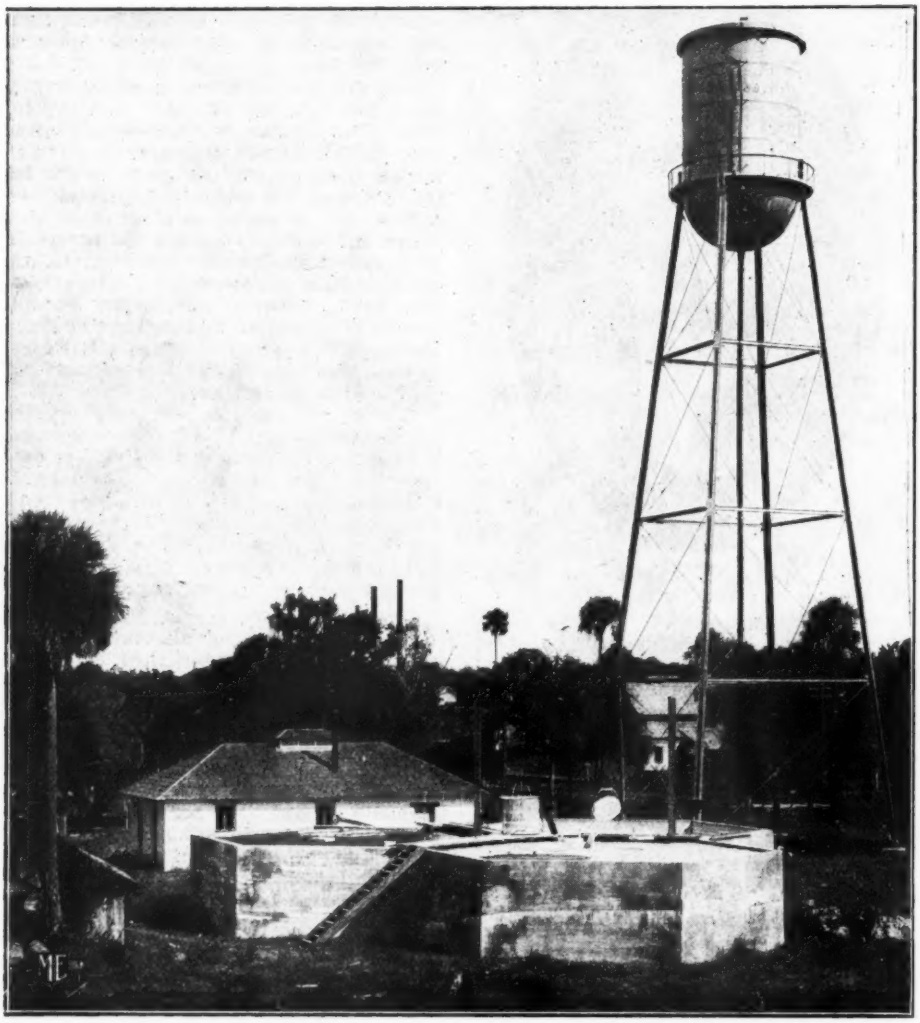
In the application of the Porter-Clarke process 2.83 pounds of hydrated lime and 0.16 pounds of soda ash for each one thousand gallons of water to be treated are weighed out and mixed into a white-wash consistency in a cypress tank above the raw water. The amounts of lime and soda vary from time to time, the above being the present requirements.

The raw water is set in motion by means of compressed air, the air being pumped into the water thru orifices in the bottoms of the reservoirs, the orifices being so arranged as to produce a rotary motion as well as vigorous vertical agitation incident to the upward escape of the air. This air agitation, which is produced by a Blaisdell compressor having a capacity of 100 feet per minute, is continued for about 55 minutes after the introduction of the chemicals. This aeration, followed by the Porter-Clarke softening process results, after six or eight hours' settling, in a water as clear and sparkling as one could desire; softened to the extent of removing all the temporary hardness and reducing the alkalinity or permanent hardness from 300 parts to the million to below 70; free from the algal growth and the condition

which fostered it; and free from the unpleasant odor; a more healthful drinking water, with the hydrogen sulphide and carbon dioxide gases removed, with the bi-carbonates and chlorides of lime and magnesium removed, with the algae removed, and only the chloride of sodium left to represent the original chlorides and the mono-carbonate of lime to the extent of less than one-fourth of the original amount of lime left to produce alkalinity. After the settling process is completed the purified water flows by gravity into the clear water basin, from which it is to be pumped into the elevated tank.

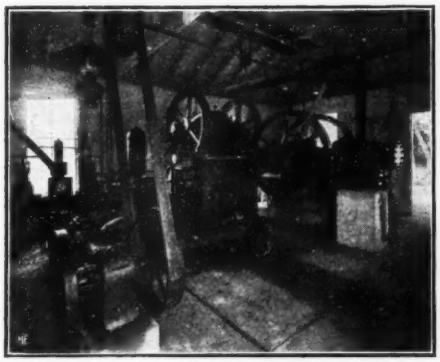
One of the accompanying photographs is taken from the rear of the pumping station. In the foreground of this view are shown the three softening and settling basins. The one farthest from the observer is nearly full of the raw water. The reservoir nearest the observer is full of water in the process of being treated, the vigorous agitation of the lime giving it a very white appearance. The reservoir to the left is full of the purified water, the outlet pipe or "dipper," which in the nearer reservoir is clearly shown above and entirely out of the water, in this reservoir being submerged ready for the removal of the purified water to the clear water basin beyond when the gate valve intervening is opened.

This arrangement of removing the clear water from the settling basins is the in-



WATER WORKS OF DAYTONA, FLA. *Settling basins in foreground. Pumping station and elevated tank in rear.*

vention of the superintendent of the plant. When the clear water has been nearly all removed from a reservoir this dipper-like outlet pipe automatically



INTERIOR OF PUMPING STATION, *Waterworks of Daytona, Fla.*

rises, swinging on its swivel and so as to raise the open end entirely above the surface of the water. This open end remains above the water during the filling, softening, and settling of the water, thus entirely preventing either the raw water or the agitated mixture from entering the outlet pipe. When the water has sufficiently settled the opening of a valve allows purified water to enter the pipe and submerge it just beneath the surface where the water is most thoroughly settled, the two square floats shown suspended in the nearer reservoir and floating in the left hand one maintaining the draw-off pipe in this surface position during the entire process of emptying the reservoir.

A photograph shows one of the two pumping units and the air compressor used for aerating and agitating the water. At the right of the pump is the gasoline engine. To the left and in the foreground is the air compressor, which occupies a point precisely in the middle of the building.

The pumping unit not shown in the cut is identical with the one shown, the arrangement being reversed so as to bring the two discharge pipes together beneath the pressure gage shown in the cut.

The pumping outfit consists of two Rumsey triplex pumps with a capacity of 750 gallons per minute each, direct connected by two Hilliard clutches to two single-cylinder 50-h.p. Foos gasoline engines. Both engines are also clutch connected to the Blaisdell compressor so that whichever engine is in operation can be used to operate the compressor and thus purify and pump at the same time. An idea of the operation of the plant may be gained by noting that while the power plant is pumping water from the clear water reservoir into the 75,000-gallon elevated tank it is also agitating the raw water and chemicals in one of the three settling basins, and that while this is going on another of the reservoirs is filling with the raw water. At least three of the settling tanks are necessary in order that there may always be a supply of the purified water on hand. As the consumption increases more settling basins may be added.

It is interesting to note that the algae do not grow in the purified water. Until the softening plant was put in operation the clear water basin contained the raw water. The rapidity of the algae growth in the hard water was almost unbelievable. The growth was so rapid that no strainer could be feasibly used and quantities of the algae passed into the mains.

The water is distributed entirely thru meters. Meters are read quarterly and bills are payable from the first to the tenth of the following month. The method of charging is that familiarly known as the "readiness to serve" plan. A quarterly charge of $1.25 for "service maintenance" plus a charge for water in proportion to the consumption makes the water bill. In view of the absolute fairness of this plan and the obvious unfairness of the somewhat common "minimum allowance" plan, the writer has often wondered that the latter plan has been so widely employed in charging for water, gas, and electricity.

At any rate this decidedly unjust minimum allowance plan has crept into public utility billing systems, and some intelligent customers and millions of the masses are being discriminated against in a way which would immediately arouse their opposition if the scheme were applied to any other community. Any fair-minded man will admit the justice of paying a fair price for the goods furnished him and a fair price for the delivery of the goods.

The cost of delivery in the case of a water service may be considered synonymous with reasonable rental on the property devoted to the patron's exclusive use. Among other items it should cover interest and depreciation on the meter and other materials furnished by the water works, the estimated cost of keeping the meter in repair, the cost of reading the meter and billing and collecting, and an estimate of the value of the water which the meter allows to pass unrecorded. In fact with a reasonable margin of profit it should be a charge for all items except water recorded by the meter. This, as is the case with everything else we buy, should be paid for in proportion to the quantity used. This plan of billing for water is simply the minimum allow-

ance plan with the unfair feature thereof cut out; the "allowance" is reduced to zero gallons, and the charge reduced to a fair price for the "service."

This briefly is the plan followed with the Daytona water works. The quarterly bill is $1.25 plus ten cents for each thousand gallons of water used, whether the consumption is 1,000 gallons per quarter or 100,000 gallons. It will be noted that this is a sliding scale, working automatically and starting at one dollar and a quarter per thousand gallons and decreasing as it should with large consumers towards a minimum of ten cents per thousand gallons. It must be understood that these figures are given merely to illustrate a principle. They have been worked out for the particular conditions here, and are working satisfactorily. The above principles, correctly applied to any water, gas, or electricity service, would, it would seem, furnish a fair plan if indeed not the only fair plan for charging for the service.

As stated in the beginning of this article, the Daytona plant acknowledges its indebtedness to others; little claim to originality is made. The best possible goods at the most equitable rates is the aim. Our patrons are largely the well-to-do who come here to enjoy the unparalleled climate and scenery which have given Daytona the enviable title of "The Prettiest Winter Resort in the World," and not the least of the attractions which this city holds out to tourists in its water supply.

Special Commissions Will Repair Ohio Flood Damages.

In the most seriously flood damaged sections of Ohio, the millions of dollars that will be required for reconstruction of public works will be spent under the direction and supervision of local flood relief commissions. These commissions will exercise the authority of the directors of service in cities and of the county commissioners in counties, according to the provisions of a newly enacted state emergency law. While exercising the authority of the service directors and county commissioners, the commissions are presumed by law to act jointly with the local officials.

Flood relief commissions were appointed under the new plan on May 19 for the cities of Columbus, Dayton and Hamilton, and for the counties of Franklin, outside of Columbus; Montgomery county, outside of Dayton, and of Butler, outside of Hamilton. Members of the Columbus commission are Joseph M. Howard, Lee M. Boda, C. Edward Born and S. M. Levy. Thru an agreement they will act also for Franklin county. The Dayton commissioners are headed by John H. Patterson, president of the National Cash Register, who did much actual flood rescue work. The other members are Walter S. Kidder, M. J. Gibbons, Frederick H. Rike. The Montgomery county commissioners are Edward A. Deeds, William Stroop, Edward C. Weber, and Eugene Wuichet. On the Hamilton commission are James K. Cullen, George P. Sohngen, Rev. J. F. McNary and Benjamin Strauss. The Butler county commission is composed of S. M. Goodman, Benjamin Harwitz, T. C. Simpson and Charles E. Mason. All of the members of each commission are residents of the respective cities and counties for which they will act.

The commission plan of flood reconstruction is based on the theory that the damage in some localities was so severe that the local officials would be unable to cope with the situation. The legislature consequently created a state flood relief commission named by the governor, and gave all flood stricken localities the right to appeal to the state commission for the appointment of local commissions to take charge of flood rehabilitation. Under the law, 10 per cent. of the voters in any city or county are sufficient to petition for state aid. When such petitions are presented to the state commission, the latter first gives the mayor of the city or the probate judge of the county the right to choose the local commission and if the mayor or the judge fails to act, the state commission does the appointing itself, acting over the heads of the local authorities. In any event, the state commission must approve all such selections made. Thus far, all of the commissions have been named by the local authority amicably and have been approved by the state commission. There are no indications now that further local commissions will be asked for.

The amount of money that will be spent in public reconstruction by the commissions named is beyond calculation but it will be enormous. It is roughly estimated that in Columbus and Franklin county the rebuilding of public works will easily reach $1,500,000 and it may go higher. In Dayton and Montgomery the loss has been much greater and the Hamilton and Butler county expenditures may run close to the Dayton expenditures. The reconstruction will include streets, bridges, levees, public buildings, schools, parks, and all manner of public works. Extensive plans for flood prevention also are being made and these will add to the amount of funds to be dispensed.

Regarding the work and duties of local commissions the new law specifically says: "The commission of any municipality shall have, in conjunction with the

director of public service all the powers and duties of the director of public service in such municipality, in so far as they may extend to the repairing, rebuilding and restoring of public works destroyed or damaged by the floods of March and April, 1913, and shall exercise and perform such powers and duties jointly with such director." In the section relating to counties the same words are used except that "county commissioners" are substituted for "director of public service."

The state commission acts in an advisory manner in flood reconstruction work. Local commissions can be removed by the appointing authority or they can voluntarily retire. Voters by petition can force an election at which local commissions can be retired or continued. None of the commissioners receive any pay for their work. Thus far the commissions consist of well known business and professional men in their respective communities.

How to Keep a Clean City

In connection with the annual arbor day program in the public schools, Mayor James B. Estee, of Montpelier, Vt., announced a "clean-up day." The arbor day exercises were held in the morning and the children were given the remainder of the day if they would put in at least two hours time in cleaning up the street and grounds about their homes, especially back yards and dumps. The "City Guards" is an organization with 1,900 children among its membership, who have subscribed to the following pledge:

"I believe in a clean city, clean house, clean streets, clean citizens and clean government. Because I believe in a clean city, I will be a "City Guard." I will obey the city's laws; I will keep my home surroundings clean; I will help to keep the streets clean; I will use clean speech; I will be helpful to others and courteous to strangers; and I will play the "clean game." I will be a loyal citizen of Montpelier and I will never bring disgrace upon her by any act of disloyalty, dishonesty or cowardice."

City to Rebate Water Bills for Parkways

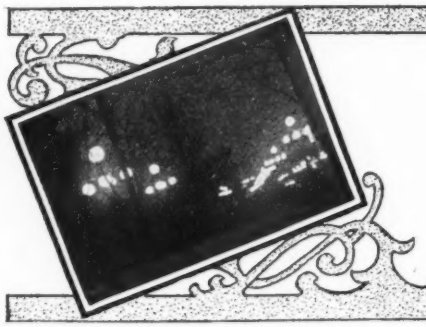
In order to encourage the citizens to keep the parkways in good condition during the summer, the city of Ontario, California, is planning to give a rebate on water bills to cover the cost of watering the strip next to the curb. This will be accomplished by taking a certain test strip of sod and keeping it well watered so that the amount of water for a square foot of lawn can be estimated. The property owners who keep their parkways green will receive a rebate on their water bill in proportion to the number of square feet of parkway under their care. This is a step in the right direction, as when water meters are installed there is a tendency to neglect the parkways by too economical householders, while the neglect of that part of the street is a detriment to the appearance of the city. In fact under the former arrangement, the careful householder who takes the trouble to care for his parkway is penalized by water rates that in the course of a year amount to the same thing as a stiff fine, while the untidy man who lets his strip of lawn die during the summer is rewarded by a lower water rate. On the face of it, such an arrangement is absurd and the Ontario plan is worth consideration by all promoters of the city beautiful idea.

Cleveland Municipal Heating Plant

A resolution has been introduced in the Cleveland, O., city council defining the territory for extensions of steam pipes from the city's Fairmount heating plant west in Euclid and Cedar avenues to 88th and 89th streets and in the adjacent territory. The pipe will cost $50,000 and the total estimated cost is $100,000. Careful record is kept of the operation of the station to secure data on which to base plans for a large plant for the downtown district.

Under-Water Coal Storage in Concrete Bins.

It is rather strange that cement, which is one of the cheapest of all commercial commodities should be used extensively for the protection of the next cheapest commodity—coal. Several thousand barrels of Universal Portland cement were used by the Indianapolis Light & Heat Co., in the construction of a huge box 100 by 300 feet and 54 feet deep in which to store over 30,000 tons of coal. This is a somewhat new development but it has been found that coal loses considerable in heating value when stored in the open and furthermore that spontaneous combustion is almost impossible to prevent when coal is stored in large piles. The storage in concrete pits makes it possible to keep the coal under water from the time it is received at the plant until ready for use, and while it adds somewhat to the expense of operation yet it is insurance against loss.



STREET LIGHTING

Seattle, Wash., Municipal Light & Power Plant

By J. D. Ross, Fellow Am. Inst. Elec. Eng's., Superintendent of Lighting.

The fight against municipal ownership of lighting plants has been a strong and persistent fight, more or less organized and not lacking in finances. On the other hand municipalities have no funds to offset these attacks nor is there any personal gain or other incentive, such as naturally characterizes private ownership. The result is that these attacks are rarely defended and a considerable number of people believe them.

The Seattle Lighting Department has taken the attitude that energetic work and consequent success will do more to offset unjust criticism than all the answers to critics that it could have written. The experience gained during nine years of the growth of the plant shows that a municipal plant has the same chances as a private concern. If the management is poor or the machinery ill chosen and inefficient, the plant is a failure. If the management is good and the machinery and equipment of the best, the plant is a success.

Competition With Companies

The Seattle plant is actively competing with two water power companies having three steam auxiliaries supplying a combined output of about 50,000 kw. in water power and 17,000 kw. in steam power. These companies, with several others in the Northwest, have lately merged, thereby becoming still stronger, claiming a combined capital of $50,000,000. The city plant has been able to compete with these concerns and has carried a considerable part of its competitor's load in times of accident and coal shortage, ranging from 1,000 to 5,000 h.p. during the periods from January 18th to 25th, 1907; March 12th to 19th; October 17th to 30th, November 22d, 1907, and September 22d to 26th, 1910, inclusive. The city plant was given a considerable part of its load during accident from flood by its competitors from November 19th to December 10th, 1911, inclusive.

Construction on our municipal plant was begun in April, 1902, and the first current was delivered in Seattle January 10, 1905.

Finances of Plant

All of the municipal light and power plant bonds are general lien bonds, and require that there be a tax levied annually to pay the interest thereon, and in making up the city's annual tax levy this item is always included, also the tax levy of 1906 included an additional item for the benefit of the plant.

In making up the annual budget each year there is included in the tax levy an item covering the annual interest on the municipal light and power plant bonds. Against this item on the credit side of the budget is entered an item equal to the total annual interest on the municipal light and power plant bonds as a refund from the light fund, thus making a reduction in the total levy equal to the total municipal light and power plant bond and interest charges. The interest on the bonds issued to build the plant is all refunded to the general fund from the earnings of the plant, and the taxpayer is in no way burdened to support the plant. A cluster, or ornamental system of lighting has been installed on the main business streets and on several streets. The cost of this system has been paid by the owners of property abutting upon these streets.

As the property owners invested the cost of the cluster lighting system, there is no interest chargeable against said cost, nor is any interest paid on said investment. The owners figure that the cluster system is a permanent improvement, and add the cost to the capitalized valuation of their property.

Charges for Service

The municipal light and power plant charges the general fund $54.00 per year per arc of 6.6 amperes, and $13.80 per year per incandescent of 40 candle power. At the time of taking over the street

JAMES DELMAGE ROSS, *is an electrical engineer, a fellow of the American Institute of Electrical Engineers, who has been interested in electrical science, design and construction most of the time since his graduation from school in Chatham, Ont., in 1890, in which place he was born. He went west in 1898, became assistant city engineer of Seattle in 1903 and later city electrical engineer and as such designed the plant which he describes, one of the largest and most successful municipal plants in the world. Since February, 1911, he has had the title of superintendent of lighting and is a member of the board of public works. He has the rather unusual pleasure of being responsible for the operation and development of the plant which he designed and built.*

Attacks have been made by the opponents of municipal ownership upon the results of the operation of the plant and it has been termed by them a municipal ownership failure but the figures and facts which Mr. Ross gives in this article clearly show that such statements are misrepresentations if not worse.

lighting by the municipal light and power plant, February 1, 1905, the city was paying the Seattle Electric Company $66.00 per year per 6.6-ampere arc, and $15.00 per year per 30-c.p. incandescent. At the time the City of Ballard was annexed to the City of Seattle, in June, 1907, that city was paying the Seattle Electric Company $66.00 per year per 6.6-ampere arc, and $13.20 per year per 20-c.p. incandescent. These prices were paid the Seattle Electric Company until the expiration of their contract with the City of Ballard, on August 31, 1910.

At the time of the annexation of Georgetown by the City of Seattle, April, 1910, the Seattle Electric Company had a contract with that city at $64.80 per 6.6-ampere arc per year. The City of Seattle paid the Seattle Electric Company at this rate per arc, and continued to do so until the expiration of the company's contract with Georgetown, in October, 1912.

At the time of the annexation of South Park, that suburb was paying the Seattle Electric Company for street lighting $21.00 per year per lamp for the 32-c.p. carbon lamp. The City of Seattle paid this rate to the company under the South Park contract, which expired in December, 1911. The municipal light and power plant charges on all 32-c.p. carbon lamps used in street lighting $9.60 per year per lamp.

At the time of taking over the street lighting system by the municipal light and power plant, the street lighting system of Seattle consisted of 213 arcs and 1,891 incandescents. The street lighting system now consists of 929 arcs and 5,876 incandescents, 100 32-c.p. carbon lamps, and 1,168 5-light, 377 3-light and 137 1-light poles in the cluster light system.

The old rate for residence lighting charged by the municipal light and power plant was as follows:

8½ for the first 20 kw. hr.
7½ for the second 20 kw. hr.
6½ for the third 20 kw. hr.
4½ for all over 60 kw. hr.

with a minimum charge of $1.00 per month.

After July 1, 1912, the rates were reduced to 6c for the first 60 kw. hr. and 4c for all over 60 kw. hr., with a 50c minimum. Rate for current for electrical appliances in the home, 3c per kw. hr. minimum charge, $1.00 per month.

The minimum charge per month of the municipal light and power plant has never been more than $1.00 for residence lighting.

In 1902 and previously consumers of electric current for residence lighting were paying 20c per kw. hr. When the agitation for a municipal plant began and it looked as if one would be constructed, the rate was dropped to 12c per kw. hr. A reduction of 40 per cent. directly due to the municipal plant.

After the municipal light and power plant began making contracts for residence lighting, in September, 1905, the Seattle Electric Company again lowered its rates, as follows:

9½c per kw. hr. for the first 20 kw. hr.
8½c per kw. hr. for the second 20 kw. hr.
7½c per kw. hr. for the third 20 kw. hr.
5c per kw. hr. for all over 60 kw. hr.

A decrease of 10 per cent. in rates, due directly to the municipal light and power plant.

The competition of the municipal light and power plant has forced the companies to make three reductions in their rates since 1902. The first of 40 per cent., the second of 16 2-/3 per cent., the third of 10 per cent.

The municipal light and power plant was constructed by the city engineer, an official who had been in that position for over seventeen years at the time he began constructing the plant, and is still city engineer. After its construction the operation and extension of the plant was turned over to the superintendent of the water and lighting department. This official had held his position about eleven years at the time he began the operation of the municipal light and power plant, and for five years he remained in charge. This official is still superintendent of the water department.

Establishment of Lighting Department

The growth of the water and lighting departments made it necessary to separate them, which was done in April, 1910. The present superintendent had active charge of the plant during its construction period as assistant city engineer, and remained with the plant as chief electrical engineer until he was appointed superintendent of lighting. This official has been with the plant from the beginning, nearly nine years. All the men holding positions of responsibility and authority have been with the plant practically from its beginning. All employes of the municipal light and power plant are under civil service rule, and are debarred from taking part in politics under pain of dismissal. The municipal light and power plant is not run by politicians and for political purposes at this time, nor has it been at any time since its inception.

Source of Power

Cedar Lake, the source of power for the Seattle municipal light and power plant, familiarly known as the city light plant, is situated in the Cascade Mountains, southeast of Seattle and at a distance of about 43 miles. The normal lake level lies at an elevation of 1,530 feet. The lake is approximately 1.91 square miles in area and drains a watershed of 79 square miles. The mountains hold a considerable amount of their snow during the early summer and fall, and so give a more continuous flow of water thruout the year. The rainfall is enormous over this district, amounting to an average of 111.01 inches per annum at the lake level, with a greater precipitation at high elevations, due to the greater chilling of the clouds in passing over the mountains.

The lake discharges at its northerly end into Cedar River, a swift mountain stream which, after tumbling thru rapids and cascades, between rocky walls for three and one-half miles, reaches a valley over 600 feet below the lake level. At this point the generating station of the city light plant is situated.

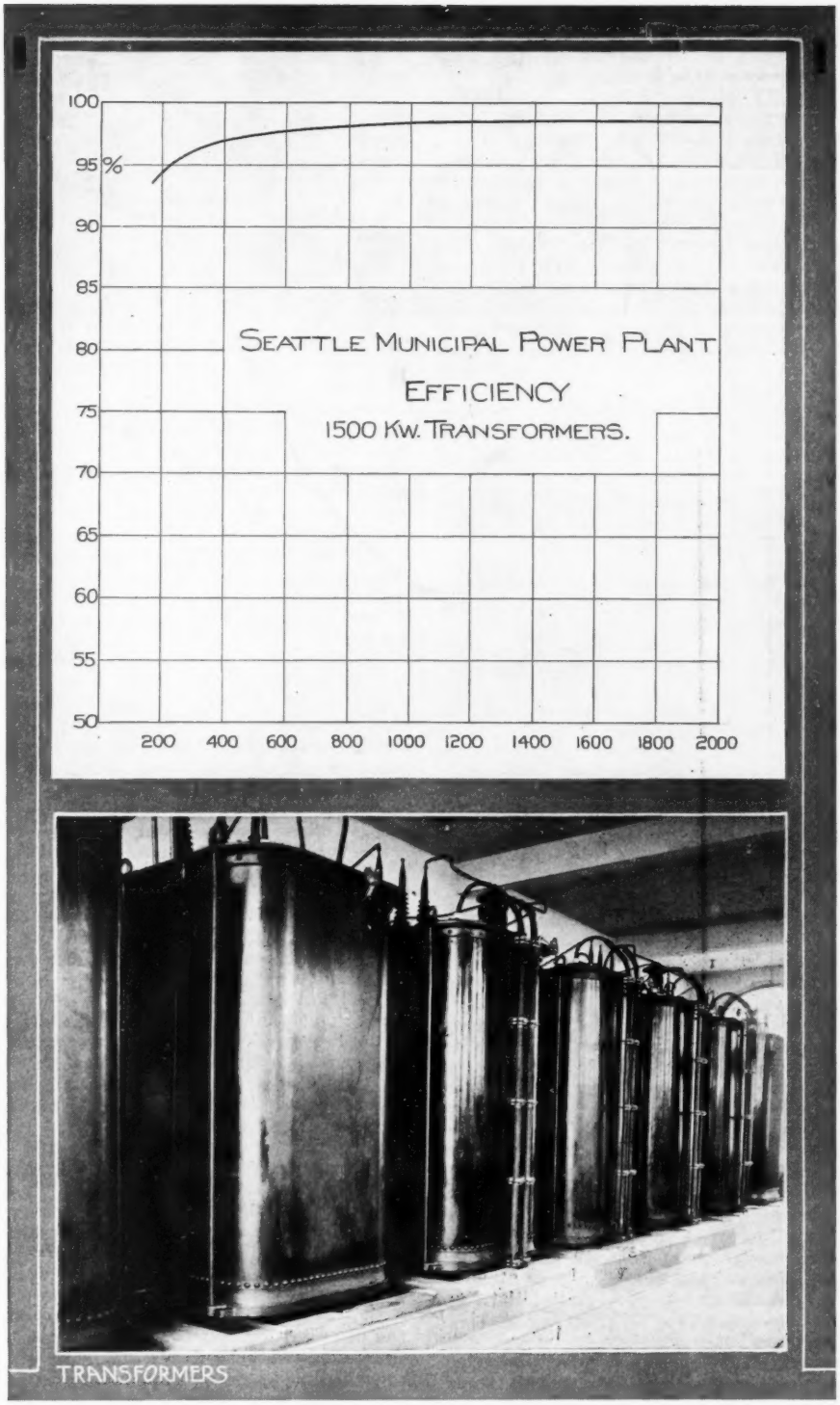
In order to supply power for the generating station, a rock-filled timber dam 250 feet across was constructed in the river about three-quarters of a mile from Cedar Lake, raising the original lake level 18 feet. This dam impounds sufficient water to operate the plant with its present needs for 90 days in dry weather, without considering the natural inflow during this time.

From the control gates at the dam two pipes, one 48-inch and one 68-inch are laid to carry the water to the plant below. These pipes are built of wood staves banded with steel for a distance of approximately 15,400 feet; the remainder of the distance, about 1,000 feet, is constructed of riveted steel pipe. Both pipes are almost entirely underground, covered with 18 inches of earth. The combined maximum capacity of these two pipes is 14,000 horse power.

The Equipment

The power house contains generators of a total maximum capacity of 18,000 horse power, all of which can be utilized by providing an additional pipe and some additional storage. To complete the plant and develop its ultimate capacity it is necessary to impound the entire run-off of the watershed. To this end a concrete dam is being constructed at a point in Cedar River two and one-quarter miles below the lake. This dam will be 720 feet long and 215 feet high and will raise the original lake level 75 feet, or an additional 58 feet above the crest of the present dam, and will increase the size of Cedar Lake to 5.23 square miles. The total power available after this work is done will be 14,950 kilowatts continuous every hour of the year. The average load for the year in the city plant will probably be about 40 per cent. of the maximum load, and consequently the machinery which can be operated from the new reservoir will be not less than 37,400 kilowatts or 50,000 horse power, measured on the switchboard at Cedar Falls Station. This is a very conservative estimate.

Cedar River is also the source of the city water supply and the new dam will greatly increase the capacity of the water system as well as of the lighting system. The water is remarkably pure and clear, and in order to maintain the best



FORT WAYNE STEP DOWN TRANSFORMERS *in Seattle City Sub-Station.*

sanitary conditions an enormous amount of timber is being cut and cleared off from the area to be overflowed by the lake when the new dam is completed.

The city power plant is situated at Cedar Falls, a town on the Chicago, Milwaukee and Puget Sound Railway.

The generators at the power house, four in number, are direct connected to water wheels, two of which are turbines and two impulse wheels, the whole being set on solid bed rock. The wheels discharge into Cedar River. The city has provided four modern houses for its employes at the power station, and two more are in process of building. Sanitation is carefully observed and all sewage is carried away from Cedar River to the Snoqualmie watershed.

The station is equipped with nine Fort Wayne transformers arranged in concrete cells in three banks, one bank to each cell. Each bank has a normal capacity of 4,500 kw. at 35 degrees C. temperature rise. Those transformers step the voltage from 2,300 to 60,000 volts three-phase star-connected. All high tension wiring is done on iron pipe framework using metal pins. The neutral of the star-connection is grounded.

These transformers were carefully tested and the all-day efficiencies computed. The maximum efficiency at full load showed 98.6 per cent. and the all-day efficiency during 1911 showed 96.1. All these transformers were in circuit continually to keep them in good condition and their core losses were continuous. They are insulated with solid ⅛-inch micanite partitions and molded mica channels on coils next to the iron core. The result of this extra insulation is that the operation of these transformers since their installation has been under all conditions all that could be desired. Eight exactly similar transformers are installed at the substation, to step the voltage down from 60,000 to 2,500 volts.

Current is generated at the power house at 2,300 volts, and stepped up to 60,000 volts for transmission to Seattle. Two entirely separate lines are used for added security to the service. These lines are each 38.7 miles in length and come over private right of way for the entire distance. All timber that could fall and touch the lines has been cut. A line patrolman is stationed at Landsberg and one at Renton. These lines enter the Seattle substation at Seventh Avenue and Yesler Way, where the voltage is stepped down to 7,500 and 2,500 for city distribution.

The distributing system includes 17,600 poles and 3,661 miles of wire operating in connection with 1,288 transformers, supplying approximately 26,000 customers, besides a street system consisting of 712 arc lamps, 217 350-c.p. and 5,876 40-c.p. series tungsten lamps lighting 643 miles of street, and 1,682 ornamental iron cluster light poles lighting 25 miles of street. Of these poles 1,168 carry five globes, 377 carry three globes, and 137 carry one globe each.

Annual Report of the General Asphalt Company

On a total volume of business during 1912 of $14,995,323, the annual report of the General Asphalt Company shows net earnings of $1,343,698. After deductions to cover maintenance costs above the reserve for this purpose, there was left a net gain to surplus of $1,120,924, as compared with $818,785 for 1911. The net gain to surplus amounts to 8.5 per cent. on the preferred stock. After paying the full 5 per cent. dividend on the $657,000 of preferred, there was earned a balance of 4.7 per cent. on the common stock.

Reduced to a basis of crude asphalt the tonnage sold and consumed amounted to 300,403 tons in 1912 as compared with 265,677 tons in 1911.

The continued development of the company's business along the lines of a manufacturing and supply company, rather than a contracting company, is shown by the fact that the sales of asphalt reached a total of $9,009,309, or more than twice the amount of the paving account and substantially larger than all the other accounts put together.

During 1912 the company constructed 1,106,287 square yards of sheet asphalt pavement, exclusive of the yardage constructed with its materials by other contractors. The latter, on the basis of asphalt tonnage delivered, constructed not less than 6,500,000 square yards, or 410 miles of streets of an average width of 27 feet. The tonnage of road asphalt increased from 20,479 tons in 1911 to 31,289 tons in 1912. Trinidad liquid asphalt for road purposes, as distinguished from street paving, increased from 4,653 tons in 1911 to 18,902 tons in 1912.

Reporting the progress of its old development in Trinidad, the report shows that the production for the year ending January 31, 1913, was 247,208 barrels as against a production of 141,233 barrels in the corresponding year previous. From February 1st the production has averaged 875 barrels a day as against an average of 675 in the year ending January 31st. The company reports the conclusion of arrangements for the development of oil in Venezuela, where explorations wells have already begun to produce.

PERSONAL

E. A. Kingsley

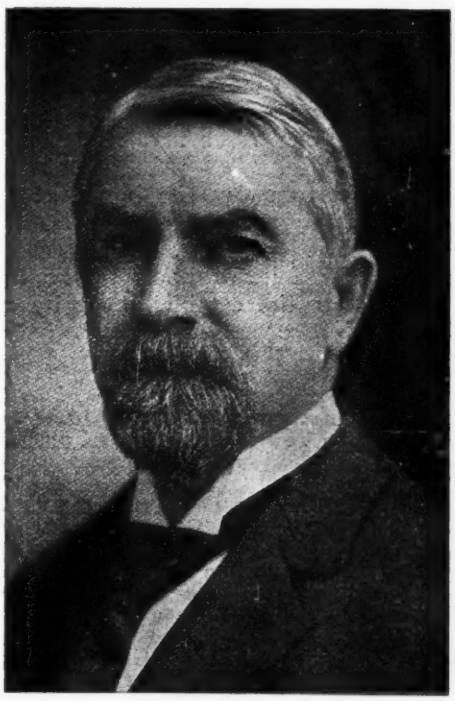
E. A. Kingsley, the first appointee to the office of State Highway Engineer of Arkansas is a graduate of Purdue University with some twenty years experience in the practice of engineering. He began in the engineering corps of Indianapolis and then went into railroad service with the Great Northern, Colorado Fuel and Iron Co., and Chicago Rock Island and Pacific, being located at Little Rock for the latter road. From this employment he was taken by Mayor Lenon and made city engineer of Little Rock and superintendent of public works, in which capacity he acted from 1904 to 1911. For the past two years he has been in private practice and has also been highway engineer for Pulaski county, building several roads as such, among them the Twelfth, Nineteenth and Arch street pikes.

Mr. Kingsley's reputation as an engineer, especially as a municipal engineer and paving expert, extends beyond the city, county and state in which he lives and has worked. Last year he was president of the American Society of Municipal Improvements, the oldest and the leading association of municipal officials and devoted particularly to municipal improvements. He has also taken an active part in the Society for Standardizing Paving Specifications and has done excellent work on the committees of that organization. He is an associate member of the American Society of Civil Engineers, and affiliated with the American Road Builders and American Highway Associations, the Arkansas Society of Engineers and other local organizations.

Mr. Kingsley is a man of ability and energy and will undoubtedly give the state excellent service in its new department.

Horace G. Burt

Horace G. Burt, late chief engineer of the Chicago Association of Commerce on smoke abatement and electrification of terminals was an engineer and railroad manager of national prominence. After his graduation from the University of Michigan in 1873 he held engineering positions on various railroads, becoming



HORACE G. BURT.

chief engineer of the Chicago & Northwestern railroad in 1881 and later division superintendent, general manager of two allied roads, third vice-president, and for six years, from 1898, president of the Union Pacific railroad. He was later receiver for the Chicago Great Western railroad and for the past three or four years has been in practice as a consulting engineer.

He was selected about a year ago for the position he held at the time of his death, on account of his special knowledge of railroad terminal problems and his committee has been notable for the value of the preliminary work it has done in the study of the very important problem which has been set for it.

His funeral at his birthplace, Terre Haute, Ind., was attended by many railroad presidents, chief engineers and officials of less degree.

Improvement of Michigan Avenue Across the Chicago River

A very important improvement of Michigan Avenue, Chicago, where it crosses the Chicago river, reached on May 20, 1913, the stage of public hearing on the resolution ordering it. The whole improvement, according to the estimates of C. D. Hill, the engineer of the board of local improvements will cost no less than $2,298,247, not including land required, but those who know the present narrow, crooked, intersected, and congested throat which the improvement covers will recognize that it is worth all it costs.

The total length of the improvement is approximately 4,500 feet. For the greater part of the distance it comprises two thorofares, one above the other. What is termed the upper level extends the whole distance named, which is from Randolph street south of the Chicago river to East Chicago avenue on the north of the river. The lower level street begins at Lake street, one block north of Randolph and extends to Indiana street, three blocks north of the river. Michigan avenue is widened on the east side south of the river, the improvement takes some private property just north of the river and Lincoln parkway is widened on the west side, so that the revised thorofare will be straight except for the slight turns which take place in the wide plazas at the two ends of the bridge across the river. The width south of the plaza at the river is 127.5 feet and north of the plaza on the north side of the river is 141 feet.

The bridge across the river is to be a double-decked bascule bridge with clear span of 220 feet, the upper deck to have two 27-foot roadways and two 15-foot sidewalks and is 90 feet wide over all. The lower deck has two 18-foot roadways and two 5-foot sidewalks and a width of 60 feet over all.

The upper level provides for the thru traffic, particularly the boulevard traffic between the north and south sides, and the lower level provides for the business traffic across the river on the present level of these business streets. Where there are the two levels, the upper thorofare is supported on an elevated steel and concrete structure. The approach to this elevation rises gradually at the south end from Randolph street to Lake street and on the north end from Ontario street to Ohio street. An approach to the upper level is provided on Lake street from Wabash avenue, and two approaches are provided on Ohio street, from Rush street on the west and St. Clair street on the east.

Lake street east of the improvement, and the two Water streets, Michigan, Illinois and Indiana streets connect with the lower level thorofare on both sides of it; also River street from the west. Concrete stairways for foot passengers connect the two levels at each of the streets named.

South of the river plaza the upper roadway is 75 feet wide, the lower roadway 41 feet 2 inches. The upper sidewalks are 30.5 feet wide and the lower sidewalks from 3 feet 10 inches to 25 feet in various places according to the demands of the changes in street lines and the elevated structure.

North of the river plaza the upper roadway is 80 feet wide and the lower about 45 feet wide. The upper sidewalks are 30.5 feet wide and the lower sidewalks about 9 feet 4 inches.

Most of the private property taken for the improvement is to provide for the plazas at the two ends of the bridge across the river. Each of them extends about 300 feet along the river, about half on each side of the center line, which is about 125 feet each side of the outer lines of the bridge or 100 feet outside the lines of the boulevard. This gives opportunity for a material widening of the roadway for use of vehicles waiting for the closing of the open bascule, for isles of safety, wide paved walks, ornamental lighting and other methods of dignifying and beautifying the approaches to the bridge, which will be one of the most notable bridges in the city.

The plazas on the lower level contain the rows of columns supporting the upper level and can have no ornamental features. They contain the houses for the operating mechanism of the bridge and are laid out with convenient roadways and sidewalks, for which there is ample room.

Architectural piers and architraves of terra cotta and balustrades of Bedford limestone are provided for at each street intersection with the double roadway section, that the appearance of the structure where seen from the sides may be in conformity with its beauty as seen from above. Granite piers are provided in addition at River street and East North Water street.

The plan for electric lighting of the roadway and plazas promises very handsome and effective groupings which will add their own beauty to the beauties of

the structure which they will reveal.

The plans are very complete in their provisions for all parts of the structure, and for connections with existing streets and structures and offer a very satisfactory solution for a large problem which has been troubling the city of Chicago for many years. Chief Engineer Hill and his associates are to be highly commended for the ability and industry which they have displayed.

The estimate of the cost is made in great detail and the summary for the various sections shows their relative importance from this point of view.

SUMMARY OF ESTIMATES.

Superstructure of bridge.....	$412,030
Machinery for bridge	84,620
Substructure for bridge	298,660
Bridge houses	61,600
Abutment walls	124,055
Total for river crossing.....	$980,965
Elevated structure	$808,729
Walls and excavations.....	307,370
Pavements	154,030
Lighting	47,153
Total cost without land.....$2,298,247	

Personal Notes

H. D. Forneri, has been reappointed city engineer of Eugene, Ore.

Dudley D. Britt has been appointed city engineer of Clarksburg, W. Va.

Albert Philips has been elected chief of fire department of Palataka, Fla.

Martin A. Rooney has been appointed smoke inspector of Nashville, Tenn.

C. F. Crabtree has been reappointed city electrician of Fort Worth, Texas.

Floyd Blevins, has been elected chief of the fire department of Globe, Ariz.

Z. E. Sevison, county engineer has also been appointed city engineer for Laramie, Wyo.

Chas. Knutter has been appointed city engineer of Ely, Minn.

A. M. Lund has been appointed city engineer of New Decatur, Ala.

John Daniels has been appointed city engineer of Dubuque, Iowa.

P. J. Lucey, has been appointed engineer of the waterworks of Holyoke, Mass.

Arthur Wadham has been appointed city engineer of Hillyard, Wash.

G. W. Heinmiller, county surveyor has been appointed city engineer of Carrington, North Dakota.

A. H. Kindrick has been appointed city engineer of McAlester, Okla.

L. M. Roesseler has been appointed city engineer of Fremont, Neb.

E. G. Bradbury and F. A. Barbour, consulting engineers, of Columbus, Ohio, and Boston, Mass., respectively, have been retained as consulting engineers on a proposed river improvement thru Tiffin, Ohio, to lessen the damage from recurring floods.

John W. Alvord, consulting engineer, of Chicago, has been retained by the city of Columbus, Ohio, to furnish plans for the protection of the city against floods.

Edwin Thacher has withdrawn from the Concrete Steel Engineering Co., and opened offices as a consulting engineer in bridge construction, particularly reinforced concrete in the Park Row building, New York city.

The Morgan Engineering Company, of Memphis, Tenn., composed of Messrs. Arthur E. Morgan and L. L. Hidinger, have been selected to make plans for flood relief at Dayton, Ohio.

Prof. Harry O. Garman, associate professor of civil engineering at Purdue University, has been appointed chief of the engineering staff of the Indiana Public Service Commission.

Louis C. Kelsey, civil and hydraulic engineer, of Portland, Ore., will design and construct a waterworks system for Amity, Ore.

Horace G. Burt, who has for several years been president of the Union Pacific Railroad Company, has done some of his best work for the committee of the Chicago Association of Commerce on smoke abatement and electrification of railway terminals of which he has been serving as chief engineer. His recent death will not stop the work for he had organized it so efficiently that it will proceed without delay.

B. F. Affleck, the general sales agent of the Universal Portland Cement Co., became associated with the company in 1900 when it had barely started in business. Then he had 40,000 barrels of cement to sell in a year; now he has 12,000,000 barrels a year to dispose of; and he could sell more if he had it. His success he attributes to his determination to know all he could about the material and what could be done with it, and to put this knowledge at the service of his customers, and his advancement to his constant effort to give his company the full value of his services, and to make that several times what he received for them, if possible.

Charles H. Pindell, assistant to the president of Warren Brothers Company, died suddenly on May 13, at the age of 32. For several years Mr. Pindell has attended many Good Roads Conventions at which he made many friends.

Col. Frank W. Buffum, of Louisiana, Mo., has been appointed State Highway Commissioner and W. S. Hawkins, deputy commissioner and ex-officio State Highway Engineer of Missouri.

Curtis Hill, recently state highway

engineer of Missouri has been appointed city engineer of Kansas City, Mo.

Mr. Frank T. Townsend, Assoc. M. Am. Soc. C. E., formerely First Assistant Engineer of the New York State Highway Department has accepted the position of Assistant Engineer in the inspection department of the Dunn Wire-Cut-Lug Brick Company, of Conneaut, Ohio. The business of the Dunn Wire-Cut-Lug Brick Company has increased to such an extent as to make it necessary to enlarge this department. Mr. Townsend is a graduate of Rensselaer Polytechnic Institute and has been with the New York State Highway Department for the past five years, principally on brick construction.

Technical Associations

The 45th annual convention of the American Society of Civil Engineers will be held in Ottawa, Can., June 17-20. The business meeting and president's address occupy one session, an illustrated lecture on Canadian engineering subjects another and receptions, garden party, and trips about the city and to engineering points of interest occupy the remainder of the time. Chas. Warren Hunt, secretary, New York.

The Seventh Chicago Cement Show will be held in the Coliseum, February 12 to 21, 1914, which covers a period of eight days and nine nights, not including Sunday, February 15. The National Association of Cement Users will hold their Tenth Annual Convention in conjunction with the show.

At the meeting of the Municipal Engineers of New York city, held May 28, Frederick W. Koop presented a paper on "Precise Leveling in New York City."

To the 4th International Congress on School Hygiene, to be held in Buffalo, N. Y., August 25-30 are invited delegates from towns, cities and states, as directly interested in its objects. Thos. A. Storey, secretary-general, College of the City of New York, New York City.

The Panama Canal was the subject of the May meting of the Colorado Association of Members Am. Soc. C. E.

The 8th annual meeting of the Federation of Trade Press Associations will be held in New York September 18-20. This association has a total membership of 236, representing over 75 different trades, industries and professions. An exceedingly interesting program of practical discussions is being arranged by W. H. Ukers, the chairman of the committee. H. M. Swetland, president, New York.

Special trains for the American Water Works Convention, to be held in Minneapolis June 23-27, will leave New York June 21 at 10.50 a. m., and Chicago June 22, both morning and evening.

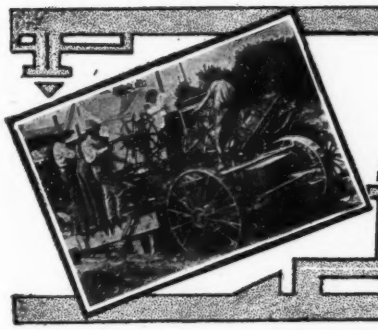
The National Conference on City Planning at Chicago May 5 and 7 was devoted to the discussion of such subjects as the city planning commission, opened by Mayor W. A. McGee of Pittsburgh; the land-tax system for public improvements, opened by Geo. E. Kessler, who described the system in use in Kansas City, which has been followed more or less closely by others; and the effect of transportation facilities on city planning, opened by Milo R. Maltbie, of the New York City Public Service Commission. The conference was of great practical value on account of the presence of so many experts in this field.

Technical Schools

"Entropy-Temperature and Transmission Diagrams for Air," by Professor C. R. Richards has just been issued as Bulletin No. 63 of the Engineering Experiment Station of the University of Illinois. This bulletin presents the theory and use of three graphical charts, by the aid of which all problems pertaining to the compression, expansion, and transmission of compressed air may be solved with a minimum of labor and with a degree of accuracy which is satisfactory to engineering work.

The dedication of the new transportation building and locomotive and mining laboratories, May 8 and 9, at the University of Illinois was made the occasion of conferences on railway and mining problems with addresses by many men of prominence in these lines.

"Tests of Reinforced Concrete Buildings Under Load," by Arthur N. Talbot and Willis A. Slater, has just been issued as Bulletin No. 64 of the Engineering Experiment Station of the University of Illinois. The design and erection of safe structures of reinforced concrete is rendered more certain by the results of experimental investigation of the stresses which are produced in building under load. Within the last few years improved apparatus and methods have been developed at the University of Illinois which have made possible the accurate measurement of stresses in the beams, columns, and floor-slabs of reinforced concrete structures. This bulletin gives the results of tests made on the floors of three large reinforced concrete buildings. It also presents a discussion of the apparatus and the testing methods used. It will be found useful to architects and structural engineers.



MACHINERY AND SUPPLIES

A New Universal Portland Cement Plant

The Universal Portland Cement Company, a subsidiary of the United States Steel Corporation, has started work on the construction of plant No. 7, at Duluth, Minn.

This plant will cost about $1,700,000, and will have an output of 1,400,000 barrels of Universal Portland Cement per annum.

The plant will be electrically operated thruout, requiring about 5,000 h. p.

Mr. Edward M. Hagar, president, states that work will be pushed as rapidly as possible, and it is expected that the plant will be in operation in 1914. With its present plants at Chicago and Pittsburgh, this plant will give the company a total output of 45,000 barrels a day, or 13,500,000 a year.

The shipments of Universal Portland Cement in 1912, 10,047,499 barrels, exceeded those of any cement company in the world.

It is interesting to note the growth of this company, as well as the percentage of its output to the total American production, as shown by the following table:

Year.	Production Portland Cement of U. S. Barrels.	Production Universal Portland Cement. Barrels.	Pct. of Universal to Total Amer.
1900....	8,482,020	32,443	.39
1901....	10,711,225	164,316	1.29
1902....	17,230,644	318,710	1.85
1903....	22,342,973	462,930	2.08
1904....	26,505,881	473,294	1.78
1905....	35,264,812	1,735,343	4.92
1906....	46,463,424	2,076,000	4.55
1907....	48,785,390	2,129,000	4.36
1908....	51,072,612	4,535,000	8.89
1909....	64,991,431	5,786,000	8.92
1910....	76,549,951	7,001,500	9.14
1911....	78,528,637	7,737,500	9.85
1912....	81,941,998	10,114,500	12.34

Good Roads for Berrien County, Michigan

That the interest in permanent roads is increasing is evident by reports which come from all parts of the country. One of the most recent is from Berrien county, Mich., where the board of commissioners voted on and authorized the issuance of $500,000 worth of bonds, the money to be used in building good roads through the country.

Two years ago the county adopted the county road system, but found this method too slow for its purpose and consequently has just accepted the bond issue plan as a more expeditious means of accomplishing the desired end. The state aid fund will amount to about $100,000, which will bring the total to be used on good roads to $600,000. This will probably be extended over a period of five years, and provision for retiring the bonds will be made from the regular tax levy extending over a term of twenty years. The members of the county board are studying the various forms of permanent road construction and they are reported to be favorable to the use of concrete. Splendid results in building concrete roads have been obtained in various localities, notably in Wayne county, (Detroit), Mich. The concrete country roads around Detroit have been visited by scores of delegations of interested road builders from all over the country. Concrete roads are already playing an important part as consumers cement. In Wayne county, Mich., 100,000 barrels of Universal Portland cement were used in 1912 and an additional 100,000 barrels of the same brand will be used in 1913.

A Fire Alarm System Using the Telephone Wires

One constant question about a district telegraph system of sending in fire alarms is as to the working of the circuits. Testing them frequently is expensive and troublesome, and if they are not tested they may be out of order at the time they are needed most. The Denio system uses the telephone wires, and they are tested every time the telephone is used. The value of the system is recognized by telephone companies as a business getter, and as a by-product of the telephone system, giving

a revenue with little or no additional expense.

In brief, the system consists, in a residence, of a fire alarm box with a glass cover, which is broken by a hammer attached to the box, and a button is pushed to send in the alarm. This cuts the telephone out during the sending of the alarm and gives a fire signal to the telephone operator at the central station, who connects the line to the register circuit, which records the box number at fire headquarters and any other desired places on the circuit, and rings any desired bells. The attendant at fire headquarters consults his running board, finds the location of the box and orders out the proper fire-fighting apparatus.

The signal is repeated sixteen rounds in one minute and forty-five seconds, altho the call may be answered in from three to six seconds, so that no chance is taken of failure to get the box number on bell or register.

The central telephone office has provisions for putting all telephone lines with fire alarms on special sections of the switchboard, with specially trained operators and with extra night alarm signals, when the number of telephone operators is less than by day. Non-interference of two or more fire alarms at the same time is also provided for if there is more than one wire to fire headquarters.

The system can be installed for automatic and for magneto telephone lines as well as the regular manual systems, by devices which have been invented, and is even easier to handle with the magneto than with other systems.

Street boxes may be used.

In factories, warehouses and the like, where it is desired to have facilities for sending in alarms from various parts of the buildings, a master box is installed and the push-button boxes set it in operation. Besides sending in the regular alarm, it can be fitted to work an annunciator to tell which box on which floor the alarm comes from. This may be outside, so that the fire department, when it arrives, will lose no time searching for the fire. The master box may also set bells or other alarms to ringing. Thermostats and connections to sprinkler heads can also be made so that the alarms will be sent out automatically.

The factory system of wiring can be tested independently of the telephone line to insure its constant working, but the attachment of the local alarms to the telephone battery insures its regular condition.

This system is now in control of the American Telephone Fire Alarm Company, 10 La Salle street, Chicago, Ill., successors to the Denio General Electric Company, and they can give full details and send booklets giving full explanations and illustrations.

Two Types of Reinforced Concrete Pavement

The city of Oakland, Cal., solved the problem of how to construct pavements on filled ground by selecting and constructing a reinforced concrete pavement on the street parallel to the United States bulkhead and estuary. The specification called for Triangle Mesh reinforcement, style No. 28, as manufactured by the American Steel and Wire Company, 25,025 square feet being used. The following extract from the magazine published by real estate interests, together with the accompanying photographs, will clearly show the bad conditions of the foundation over which this reinforced concrete pavement was placed.

"One of the most difficult engineering problems that has presented itself to the Board of Public Works has been the construction of a street giving access between the piers and the various business concerns adjacent to the made-ground.

"An unstable clay foundation, which has not yet dried out, afforded but little more than a spongy mass as a road basis. When it is considered that these streets must be suitable for hauling heavy machinery, possibly ten tons to the load, the character of the problem is evident.

"The necessity for permanent construction rejected the idea of a corduroy road of wood and the soft character of the foundation made macadam totally unsuitable for the heavy traffic.

"It was finally decided to lay a six-inch concrete slab reinforced near the bottom with a steel wire mesh. Upon especially soft spots a second thickness of the wire fabric was laid at right angles to the other.

"This Triangle Mesh reinforced roadway is giving good service and bids fair to solve one of the greatest problems of road building."

The design, supervision and construction were taken care of by Perry F. Brown, City Engineer; Harry Anderson, Commissioner of Public Works; T. E. Risley, Assistant City Engineer in charge of harbor improvements; Ransome-Crummey Company, contractors.

The Long Island motor parkway, constructed during the year 1908, is another type of a reinforced pavement. The work was done by the Hassam Paving Company, and constructed in accordance with their patents. After preparing the roadbed, about 2 inches of crushed stone was laid and on top of this was placed Triangle Mesh reinforced style No. 8, the longitudinal wires being placed parallel with the direction of the pavement. Then

REINFORCED CONCRETE PAVEMENT *on filled ground parallel to U. S. bulkhead and estuary, Oakland, California. Triangle mesh wire fabric used as reinforcing.*

additional crushed stone was placed of a sufficient depth to make the total finished slabe 4 inches thick after rolling with a 10-ton roller. A sand and gravel grout was then poured over the entire area until all the voids of the stone were filled and a sufficient amount remained on the surface to produce a smooth finish. Ten miles of this roadway 28 feet wide were laid without any expansion joints. The reinforcement was used to give added strength to the pavement and prevent depressions forming due to settlement of the foundation under the heavy automobile loads. Although the road has given very good satisfaction, the amount of reinforcement used was insufficient to prevent cracks forming across the pavement at regular intervals. The reinforcement used consisted of No. 12½ gage wires spaced 4 inches apart longitudinally and No. 14 gage diagonal cross wires spaced to form a 4-inch mesh. This is an exceptionally light material and should not be expected to prevent temperature cracks in pavements having no expansion joints.

A Reinforced Concrete Chimney for the Municipal Water Plant, Clarksville, Tenn.

For chimney construction, reinforced concrete has come into very general use and occupies an undisputed position in this interesting field. It combines in a single structure all the elements of stability, strength and durability, and possesses all the requisites of a structure built with a view of permanence and beauty.

The reinforced concrete chimney has particularly found favor in municipal work, and has been adopted extensively for municipal electric light, gas and water plants, and the chimney described below, which was designed and built by The Weber Chimney Company, Chicago, gives an illustration of the successful use of this type of chimney at the water works plant of the city of Clarksville, Tenn.

The reinforced concrete chimney in question is of the type known as the Weber coniform chimney, so called by reason of its shape, the shaft being built as a true frustum of a cone. The chimney at all sections of its height is a true circle and the sides of the shaft are tapered at a uniform rate from top of chimney to top of foundation. The component parts are designed in accordance with the best engineering practice and the recognized and generally accepted formulas of professors Turneaure and Maurer are used as a basis for design.

The Clarksville chimney is 155 feet 6 inches above grade by 4 feet 6 inches internal diameter at the top, and was designed to withstand a wind pressure of 25 pounds per square foot of projected chimney diameter, which is equivalent to the pressure caused by wind with a velocity of 100 miles per hour. All tensile stress caused by the wind is taken up by vertical bars spaced uniformly around the shaft wall, ample vertical steel being provided so that the resultant unit stress in the steel will never exceed 14,000 pounds per square inch. The bars were placed about 2 inches from the outer face of the concrete. The horizontal reinforcement consists of ½-inch rings, the spacing of which was made dependent upon their lo-

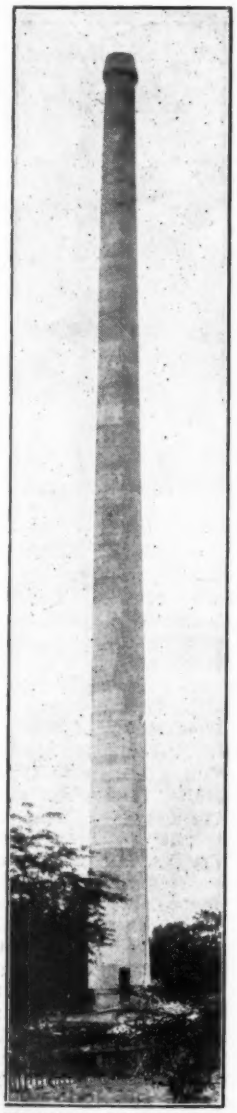
cation. At all points where the chimney shaft is subject to heavy wind or temperature stresses these rings were very closely spaced to take up and distribute these stresses without the least injury to the walls of the shaft.

All compressive stresses produced by wind or temperatures are taken up by the concrete, the wall at all sections being made of sufficient thickness to keep down the compression to a very low and conservative figure.

As a protection against the hot smoke gases which would otherwise directly impringe upon the reinforced wall of the shaft, the chimney was lined with a reinforced concrete lining 54 feet high, the same built entirely independent of the shaft. A 4-inch air space was provided between the lining and shaft as a further protection. This type of lining has proven very successful in this as well as in several hundred other chimneys and is being built exclusively by the Weber Chimney Company who guarantee the same to successfully withstand all temperatures ordinarily met with in boiler practice.

The foundation is 18 feet square in plan and provides sufficient area to limit the maximum bearing on soil due to dead load and the wind load noted above to 2¼ tons per square foot. All bending stresses in the foundation are taken up by a system of horizontal reinforcement consisting of two rectangular nets and two diagonal nets of steel bars.

The shaft of the chimney was built with Weber patented unit wood forms, two sets of forms being used simultaneously, one on top of the other. These forms are made up in units which permit adjustment to a true circle of any diameter. The use of two sets of forms allows ample time for the concrete to set and avoids any possibility of the freshly poured concrete being distributed or broken up while raising forms, since the forms used are not raised as a whole but are divided into sections and each section is raised independently and again assembled.



WEBER CONIFORM CHIMNEY, *Clarksville, Tenn., water works. Lehigh cement used.*

All materials entering into the construction of the chimney were carefully tested in accordance with the requirements of the American Society for Testing Materials, which is the usual practice of the designers and builders of this chimney. The work was carried on under the direction of an experienced superintendent and was completed in May, 1912.

The strength of the construction is shown by the fact that a similar chimney at the water works plant of Council Bluffs, Iowa, went thru the recent cyclone which swept over Omaha, Neb., and Council Bluffs without the slightest injurious effect, altho the wind velocities were estimated to reach one hundred and twenty-five miles an hour. S. L. Etnyre is the superintendent of the Council Bluffs water works and selected this type of chimney after most careful consideration and bids upon all different types. This chimney is 138 feet 6 inches high and 5 feet 6 inches inside diameter at the top. An inner wall, which acts as a lining and is built of reinforced concrete, extends to a height of forty feet six inches. Both inside and outside diameters of the chimney decrease uniformly from the base to the top, the two cones, having the same vertical axis but slightly differing slopes.

Settling Basin, Erie, Pa.

By Frank Wilcox, Engineer and Superintendent T. A. Gillespie Co., Contractors, Pittsburgh, Pa.

The settling basins at Erie, Pa., have proven to be very successful and are removing about 80 per cent. of the solid matter from the lake water. We excavated for these two settling basins on Presque Isle in 1909 and they were used

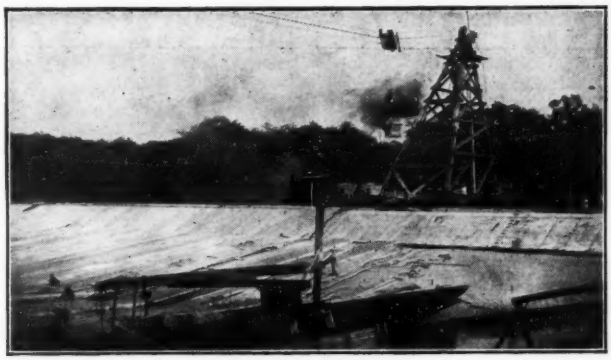
without lining until 1911. We then cleaned out the eastern basin and placed a 12-inch concrete lining all over the bottom and slopes.

The principal dimensions of Basin No. 1 (eastern basin) are as follows: Floor 500 by 320 feet; top of slopes 652 by 462 feet; depth from top of coping to top of floor 17 feet; bottom lining 12 inches thick; total area of basin, 6.9 acres; amount of concrete in lining 8,543 cubic yards.

The work was started in the spring of 1911 and finished about October 1, 1911. The concrete was mixed by a Haines mixer, carried by buckets on trains to the cableway and placed by the cableway.

Engineers were very particular in the selection of cement used in this work. Very thorough tests were made in accordance with the methods recommended by the committee of the American Society of Civil Engineers on uniform tests of cement. Briquettes made for testing tensile strength were broken with the Fairbanks testing machines. In every case where it was indicated that the cement was of inferior quality, duplicate tests were immediately made to make sure that no errors could creep into the laboratory work. Re-tests were made whenever the results of tests appeared questionable, even though they might have warranted the passing of the cement.

This basin covers five acres of ground and has a holding capacity of 24,000,000 gallons of water. Between 10,000 and 12,000 barrels of Lehigh Portland cement were used.



PLACING CONCRETE LINING *in settling basin No. 1, Erie, Pa.*

Mechanical Trench Tamping

Several prominent western municipalities are considering the advisability of specifying that the back-fill on their trenches be mechanically tamped.

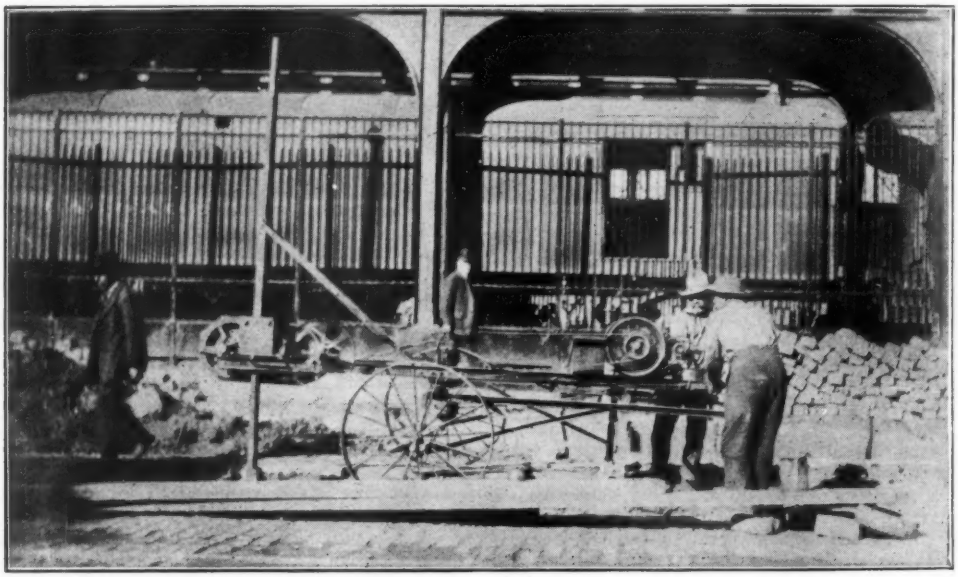
The Staley Tamping Machine, as made by the Lourie Mfg. Co., Springfield, Ill., which was among the pioneers in the field, has been considerably improved and fully one hundred of these machines are now in operation.

This machine consists of two principal parts: the sweep on which are mounted the lifting mechanism, the engine, etc., and the two-wheeled truck on which is mounted the sweep. The sweep of the standard machine is built of two 3-inch steel channels with the necessary spacers, bracing and truss rod. The sweep is mounted near its center of gravity, on a saddle casting which has a bearing on a pivot on the truck axle. The sweep swings in a horizontal direction on this pivot, thus moving the tamper across the work, while the movement along the work is had by moving the truck forward or backward about 8 inches for each complete swing of the sweep. The truck of the standard machine has 4 by 36-inch steel wheels; 1½-inch steel axle, arched; the truck-frame is formed of one piece of 2 by 2¼-inch angle, and a 2 by ⅜-inch angle crossbar riveted to the frame and legs; the legs are 2 by 2¼-inch angle; the bracing 1¼ by 1¼-inch angle. The steel axle spindle is cast into a square socket, thru which passes the vertical leg of the axle; the axle at this point is pivoted with about 8 inches of vertical adjustment, and a like amount of adjustment is provided in the cast iron shoe on the bottom of the truck legs. This adjustment will allow the machine to be operated with one wheel on the curb or other unlevel surface, and is a valuable feature when the machine is required to work close up to the curb.

The lifting mechanism is very similar to the well known board drop-hammer used for years in drop-forge shops. The mechanism as applied to the power tamp-

ing machine is even more simple than the drop-hammer. This lifting mechanism consists of two parallel rolls mounted on shafts running in bearings bolted to the sweep: the rolls are geared together by spur gears, and are driven by a pinion gearing into the gear on the rear roll; the driving shaft runs in bearings bolted to the sweep. The rolls and shaft are kept in line and adjustment by steel tie-rods which pass thru all the bearings and have nuts and lock nuts on each side of each bearing. The front lifting roll is pressed against the lifting board by coiled springs on the tie-rods passing thru the bearings and adjustable by nuts and washers. The length of stroke and gripping and releasing of the lifting board are automatically regulated by cutting away a part of the circumference of the lifting rolls. Thus the board is automatically gripped, raised and released, once for each revolution of the lifting rolls. The lifting board is of hardwood reinforced with a small steel channel on the edges and slides in long steel channel guides riveted to the sweep channels with a heavy gusset-plate, and braced from the top back to the sweep. Mounted in the gusset-plates just above the lifting rods, is a pair of grips or dogs which are connected by a short lever and bell crank; these grips are normally pressed against the lifting board by a coil spring acting on the bell crank, but when the lifting board is in motion the grips are held out of contact with it by a small rod and latch placed near the left hand of the operator. When it is desired to stop the motion of the tamper the latch is replaced and the grips prevent the board falling, but allow the lifting rolls to raise it the length of the stroke at each revolution, while the board is prevented from rising above a fixed point by reducing the thickness of the board near the lower end. When the reduced section rises to the center of the rolls, they do not grip the board and it thus remains in this position until it is released by the operator.

With the standard sized machine using a tamping head 8 by 9 inches in area, two laborers can tamp from 1,200 to 1,500 square feet of surface per hour, making one pass over the same. On trench work the machine will tamp ten layers in from 40 to 50 lineal feet of trench 30 inches wide per hour, making one pass over each layer. This machine will strike any square inch in a trench from 1 to 4 feet wide; it will strike any point at any level from 1 foot above the surface to 6 feet below. Number of blows per minute, 50 to 60. Length of stroke, 2 feet; weight of tamping head, 80 to 90 pounds; size of regular head 8 by 9 inches. Net weight about 950 pounds. Shipping weight about 1,250 pounds.



STALEY *Trench Tamping Machine in operation.*

The machine is regularly equipped with a ten-foot lifting board, which will allow the tamper to reach a depth of 6 feet below the surface, which on account of the powerful blow struck by the machine will be found to answer for a depth of 8 to 9 feet. Where conditions require it, the

lifting board may be made in any length up to about 16 feet, which will allow the tamper to reach a depth of 12 feet below the surface. When the board is made longer, the weight of the tamping head is reduced to keep the total weight down to about 85 pounds, and the head is sometimes made of steel angles and plate. When the machine is to be used on surface work alone the sweep may be mounted on a narrow truck which will allow the tamper to cover an area wider than the over-all width of the truck, thus tamping a track for the wheels, and enabling the machine to clear fences, gates and posts, when used on sidewalk work. For extra wide trenches the truck may be built on a wider gage and of heavier material to meet the requirements. One sweep may be furnished with two trucks of different gage, and the sweep may be changed to either truck in a few minutes by removing four small bolts, and of course either truck may be used on any kind of work up to its capacity.

While one man can handle the machine on small trenches and surface work where the footing is good, on trenches that are wide or where the footing is soft, it will pay to have two laborers handle the machine, putting one man on each side of the machine, where they will be in the best position to keep the machine moving along the work and the sweep across. The power machine with two men to handle it should do as much work as from 8 to 10 men using the hand tampers, as the power machine will not shorten the stroke or reduce the number per minute, for this is automatically regulated, and the operator can give his whole attention to moving the machine over the work.

Concrete Sidewalk Construction

By Spencer Bros., Kokomo, Ind.

Proper mixing is frequently neglected in sidewalk work and it must be carefully watched. An excess of water must be avoided. It is not practicable to use as wet concrete in sidewalk construction as in some other classes of work. The top coating should have much more water than the lower layer and be of such a consistency as to work well under a trowel.

One of the common mistakes made by inexperienced workers is to mix too large a batch at one time; and then when the mortar has begun to set before it could be placed, to attempt to remix or retemper same. Under no circumstances should this be done, as once concrete or mortar has taken its initial set, or begun the hardening or drying out process, the addition of water or mixing will not delay this process. Any remixing of concrete after hardening has begun will generally weaken it to such an extent as to make it unsatisfactory. The saving which may result from the use of a portion of a batch of concrete which is retempered will not justify the introduction of uncertainties into the work. Retempered concrete should not be used. Any concrete left over at quitting time should be wasted.

In transporting concrete, care must be taken to prevent loss of material in any way. Wheelbarrows must not be overloaded. Loss of any surplus water in the mixture may rob it of a portion of the cement carried in suspension.

The concrete should be deposited within the forms on a subbase previously wet and tamped into final position as soon as possible. The surface of the concrete should be brought to a plane parallel to the proposed finished surface of the walk, and at a distance below it equal to the thickness of the wearing surface. To insure this the concrete should be struck with a straight edge long enough to span the walk, and notched out at the ends so that when placed on the side forms the straight edge will define the correct grade of the base.

The concrete should be dumped, not thrown or dropped from a height, as this tends to separate the stone from the mortar. No concrete should be placed upon a dry sub-grade. If this precaution is not taken it is certain that the porous material, absorbing a considerable quantity of water, will rob the concrete of much of the moisture it needs for proper crystallization and curing. The inspector should make certain that the specified proportions are accurately and uniformly adhered to. Mortar should be thoroly mixed and not allowed to look raw when deposited on the concrete base. If the mortar is not uniformly mixed, the surface will be irregularly colored and will contain pitted and honey-combed spots. Variable proportions of water should be avoided. A mortar mixed dry gives a darker finish than a wet one. The opposite sides of a stretch of walk will frequently appear to be of different shades, as the result of half of it being finished from one side, while the other half was finished from the opposite side.

The character of the finishing tool used in troweling the surface will affect the color or shade of the walk. A steel trowel gives a darker finish than a wooden trowel or float. If the top mortar is allowed to become too dry after being floated, and then finished with a steel trowel, it is apt to contain blotches which remain indefinitely.

In our sidewalk constructions we use the Standard low-charging mixers furnished us by the Standard Scale & Supply Co. These mixers on account of their having no charging device or special

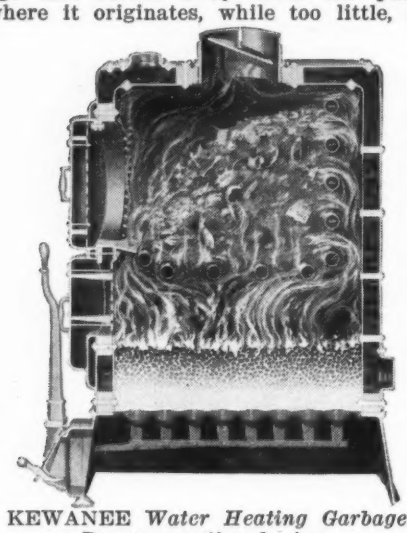
mechanism other than the simple equipment and the mixing drum with low charging platform are simpler and more compact than most batch mixers. This enables the workman on the job to move the mixer in a small fraction of the time required to move large batch mixers and, in work requiring frequent moving, such as sidewalk construction, the mixer frequently pays for itself in a few months' time by the greater economy in moving alone.

We find it possible to conveniently keep these mixers in best position for rapid work. One of these mixers and a small gang of men will lay from two to three times as much sidewalk as the same number of men will accomplish mixing by hand, and the concrete is of far better quality. The machine will mix the top dressing as well as the base.

The Question of Garbage Disposal

By Elmer S. Leffel, Inspecting Engineer for Lehmann & Williams, Sanitary Engineers, Boston, Mass.

The city councils of various municipalities, city and state boards of health, health officers generally and improvement societies, have been spending considerable time during the last few months agitating the question of garbage disposal. Much attention is given to considering the various methods of destroying garbage and refuse away from the place where it originates, while too little, or



KEWANEE *Water Heating Garbage Burner, sectional view.*

no attention at all, is given to the disposal of garbage at the place of its origin.

Manifestly, the cleanly way of disposing of garbage is by incineration. And if the garbage is destroyed thru burning while it is still fresh and untainted, it is a big advantage.

The garbage can is a birthplace of disease. On all sides we hear "Swat the fly," but the fly is a means of carrying disease rather than the source. The garbage can and the garbage wagon are both necessary to the breeding of flies. Eliminate the garbage can, the fly's dinner table, and you eliminate the fly. Furthermore, the destruction of garbage, by burning while it is still fresh, does away with the necessity of hauling it thru the city to the dump heap or to the isolated incinerator or reduction plant. Nothing is more disagreeable to the inhabitants of the city than the garbage wagon, in addition to the fact that it is a positive detriment to health.

There is another very important point in favor of the destruction of garbage at its place of origin. One ton of garbage contains, in heat value, the equivalent of 200 pounds of coal. Hence, garbage is worth as fuel, one-tenth of the price of coal. Therefore, the owner who has his garbage hauled away, is actually giving away good heat producing matter. In some cases he must pay to have it hauled away.

One big step forward toward the final solution of the garbage problem is undoubtedly the installation of garbage burners, in restaurants, hotels, hospitals, apartment buildings, and larger residences. Obviously the apartment building containing two, four, six or more families is a large producer of garbage. And figures have been compiled which prove beyond any doubt that a law compelling apartment owners to install garbage burners would be not an imposed hardship but an imposed economy upon the owner.

The problem of garbage disposal and the problem of hot water supply have become strangely related. There are today on the market several types of garbage burners which will satisfactorily burn garbage and refuse and at the same time use the garbage as fuel for heating water for domestic purposes. One type of the garbage burner mentioned is manufactured by the Kewanee Boiler Company, of Kewanee, Ill., and is known as the Kewanee water heating garbage burner. Figures which have been supplied to this concern, by owners of apartment buildings who have installed this garbage burner, show that the average cost of burning the garbage and of supplying hot water to the tenants of an apartment building is about 2 1/3 cents per day per apartment.

The Maryland Hotel, St. Louis, installed one of these garbage burners a year or more ago, and they report that

it is giving extreme satisfaction. This hotel has 125 baths, 255 washstands, and kitchen facilities large enough to take care of 1,000 people. Their statement is that this garbage burner not only supplies them all the hot water they use, but burns all the rubbish and trash, about twenty barrels per day, at a cost of 65 cents per day.

Further opportunity for the economical use of a garbage burner of this type is shown in the installation of a Kewanee water heating garbage burner in the ten-story and basement building, owned and occupied by Messrs. Lewis & Conger, New York City. The entire basement of this building is used as a shipping and receiving room, in the boiler room of which is placed a Kewanee garbage burner connected to a horizontal storage tank of 250 gallons capacity.

The burner is used to consume the waste material accumulating around the shipping, packing and receiving rooms, and this refuse, used as fuel, with the addition of 150 pounds of coal per day, furnishes sufficient heat to supply the entire building with hot water. This building requires about 2,500 gallons of hot water per day. The amount of heat required to raise the temperature of that amount of water 150 degrees, is approximately 3,200,000 heat units. In a pound of coal there are about 8,000 heat units, therefore, the 150 pounds of coal used supplies 1,200,000 of the 3,200,000 heat units wanted. Therefore the garbage, waste, straw, hay and paper used in the garbage burner provide two-thirds of the fuel necessary to heat all of the water used in this building. In other words, the waste material consumed is equivalent in value to from 250 to 300 pounds of coal. A fair average price of coal in New York City is $6.50 per ton, which makes it a fair figure to estimate the worth of this waste matter used, from a fuel standpoint, at from 82 to 90 cents per day. In this case the value is really three-fold. The rubbish, old papers, etc., are gotten out of the way, necessary hot water is heated and the fire risk is greatly reduced.

It would, of course, be folly to recommend the installation of a garbage burner in every establishment, but there is absolutely no doubt but what in a great many establishments, and this is possibly always true in the case of apartment buildings, a garbage burner would eliminote the garbage and would at the same time effect an economy for the owner in reducing the cost of the hot water which he must furnish his tenants.

The Clark Meter Box

By W. F. Anderson, Supt., Effingham Water Works, Effingham, Illinois.

We have forty Clark meter boxes installed in sidewalks in this city, while but six are placed in pavements. We have 50 of these boxes in all, housing ⅝-inch and ¾-inch meters. These boxes, the average first cost of which is $3.50, can be installed anywhere and under all conditions.

The special combination type in use in this city has vitrified earth-box body 18 inches inside diameter.

We place the meters from 1 to 2 feet below the surface and 2 feet above the frost line as we believe that this location renders most convenient reading of meter. The bottom of the box itself extends 6 inches below the frost line. The partial burying of the cover with the sidewalk or other material, combined with the dead air space within the box and the radiating surface of the warm air at the bottom of the box insures absolute protection from frost. We have never experienced any freezing of our meters when housed as above described.

The following table giving degrees of temperatures inside and outside of box in extremely cold weather on the different dates mentioned, is indicative of the efficiency of these boxes:

Date.	Temp. in box.	Temp. outside.	Ground frozen.
Feb. 2, '12	48	10 below zero	14 in.
Feb. 20, '13	52	20 below zero	6 in.
Feb. 27, '13	46	10 below zero	12 in.

Many of our ordinary or basement installations of meters froze on above mentioned dates.

It may be interesting to know that snow or ice does not ordinarily collect on the covers of our meter boxes as the warmth of the air inside of box is sufficient to keep the cover at such a temperature that snow melts as fast as it falls on the cover. We have never experienced any trouble on account of breakage of lids or covers and we believe they are built heavy enough to withstand the most severe traffic conditions.

We have never experienced any trouble with the locking device, which we believe is exceedingly simple in operation as well as speedy, as it requires our inspectors an average of one minute to unlock, make the reading and again lock the box.

We have made it a practice of furnishing sidewalk contractors with temporary covers with ring forms for their use in the laying of sidewalks. These temporary covers and ring forms are exceedingly simple in operation and enable the contractor to proceed with his sidewalk con-

struction with hardly any loss of time. These castings are very carefully made and are of exactly true pattern.

Outside installations are accessible at all times and it is our belief that those municipalities having outside installations can cut down their cost of meter inspection fully 50 per cent. Fully 40 per cent. of our installations now have outside housings and we contemplate this systematic setting of our meters thruout our whole system. In other words all meters installed from this time on will have outside housings in accordance with above described method. These meter boxes are furnished us by the H. W. Clark Company, Mattoon, Illinois.

Sheridan Boulevard Pavement Extension Successful

Numerous boulevard improvements and drive extensions are planned for the three park systems of Chicago. The experimental 40-foot drive which extended the Sheridan road pavement a distance of 4,631 feet in 1910 has been pronounced a success. The stretch was so built as to allow the water to run off the street onto the lawn at the side, which is graded so as to form a hollow along each side of the road. The road is 40 feet wide with a 7-inch crown, and has 2 inches of asphalt on an 8-inch base of crushed stone. At the sides of the drive are reinforced concrete curbs 5 inches thick, extending from the surface of the street 24 inches deep. The top ½ inch of the curb is surfaced with a grout containing ½ pound of lamp black per bag of cement, for the purpose of giving the top of the curb the same appearance as the asphalt street. Many similar extensions are contemplated.

The concrete curb was formed by 16-foot panel forms, of which there were about 500 lineal feet employed. The curb was reinforced with three ½-inch square bars. These were 20 feet long and lapped 6 inches at the ends. They were suspended in the forms in templets made of a ¼-inch piece of pine, which was left in place to form the expansion joint.

The total amount of asphalt upon the street amounted to 22,318 square yards, and was placed 2 inches thick. The material was mixed in a Twentieth Century portable asphalt paving plant as manufactured by the Link Belt Co., Chicago, in the following proportions:

	Lbs.
1 part torpedo sand	168
1 part bank sand	168
3 parts ½-inch stone	504
Asphalt	81
Total 7 cubic feet or 1 box	921

The asphalt used was a fluxed Gilsonite. Part of the work was done with Sarco and part with Pioneer asphalt. Altho the work has been laid three years, it has nevertheless shown no signs of wear or deterioration under a heavy automobile traffic. The asphalt work was commenced April 29th, and was completed July 9, 1910. The costs follow:

Labor.	Time, hrs.	Rate.	Total.
Engineering			$ 57.18
Foreman	566½	$150.00 mo.	362.01
Sub-foreman	2	125.00 mo.	1.07
Sub-foreman	28	3.00 day.	9.33
Sub-foreman	4	2.50 day.	1.10
Troy dump wagons	439	.66 2/3 hr.	159.29
Troy dump wagons	421½	.25 hr.	105.38
Two wheel carts	469	12½ hr.	57.63
Common labor	1,579	.38 hr.	608.10
Common labor	18	.35 hr.	5.30
Common labor	1,510	.30 hr.	453.00
Common labor	13	2.50 day.	3.61
Skilled labor	16,122½	.25 hr.	4,030.63
Timekeeper	97	65.00 mo.	25.25
Steam roller engineer	1,836½	.50 hr.	918.25
Machine man	438	3.15 day.	153.12
Machine man	325	2.80 day.	100.17
Teamsters	8	2.62 day.	2.34
Teamsters	878	60.00 mo.	224.70
Tools			479.88
Derrick			60.00
Total cost			$7,817.34
Labor cost per square yard			$0.352

Reinforced Concrete Pavements in St. Johns, Hamtramck, Port Huron and Rockville

The city of St. Johns, Mich., laid during 1913 approximately 15,000 square yards of reinforced concrete pavement consisting of a base 5 inches thick mixed in the proportion of one part portland cement to seven parts of gravel including sand. The top or wearing course is 2 inches thick, mixed in the proportion of one part of portland cement to three parts of clean sharp sand. Triangle Mesh reinforcement, style 29, was used as a reinforcement, the same being placed be-

tween the base and wearing course. Expansion joints were constructed along the curbs and across the street every 30 feet, all joints being protected with the Baker armor plate, which consists of a flat piece of steel about 3/16 of an inch thick and 2½ inches wide, bent to conform to the shape of the finished pavement. Two plates are used in each joint and are separated from ¼ to ⅜ of an inch. They are held in place by means of shear members which occur about 12 inches apart and are bent back at right angles to the plate and extend into the concrete. This pavement was designed and supervised by E. G. Hulse, city engineer, the contractor being James A. McKay, of Clare, Mich.

A very successful reinforced concrete pavement has been laid in Hamtramck, Mich., a suburb of Detroit, the same having been designed and constructed by the R. D. Baker Company, Detroit, Mich. During the year 1913, 15,000 square yards were laid, having a base 5 inches thick, consisting of a concrete mixture of one part portland cement, three parts of sand and six parts of crushed stone. The wearing course is 2 inches thick, mixed in a proportion of one part portland cement, one part of sand and two parts of crushed granite having a size not to exceed ½-inch. The reinforcement used was Triangle Mesh, style 28, placed between the base and top course, and was laid with the longitudinal wires at right angles to the center line of the street. Expansion joints were placed along the curbs and every 30 feet across the street, and were protected by means of the Baker armor plates. The cost of the finished pavement was $1.35 per square yard exclusive of excavation, the material and labor costs being as follows:

Cement, $1.02 per barrel.
Sand, 75 cents per cubic yard.
Crushed stone, $1.15 per cubic yard.
Crushed granite, $3.15 per cubic yard.
All above being f. o. b. cars, Hamtramck,.
Common labor cost $2.60 per day.

The city of Port Huron, Mich., laid about 9,000 square yards of reinforced concrete pavement in the year 1912. This pavement had a total thickness of 7 inches, consisting of a 5½-inch base and a 1½-inch wearing course. The concrete for the base was mixed one part portland cement to five parts of river-run gravel. The wearing course consisted of one part cement, one and one-half parts sand, and one and one-half parts of ¾-inch crushed field stone. Triangle Mesh reinforcement, style 4, was placed between the top and bottom courses. Expansion joints were placed every 16 feet across the street, and, where car tracks occurred, joints were placed one foot from the track on each side for the full length of the street. All joints were protected by the Baker armor plate. The price of the finished pavement was $1.22 per square yard exclusive of excavation. The material and labor costs were as follows:

Cement, per barrel.....$1.02
Sand, per cu. yd., f. o. b. the work... 1.15
Gravel, per cu. yd., f. o. b. the work.. 1.15
Common labor was $2.25 to $3.00 per day.

The designing engineer was E. R. Whitmore, Port Huron, Mich., the contractors being J. H. Baker & Son, Port Huron, Mich.

The city of Rockville, Ind., constructed during 1912, 4,400 square yards of reinforced concrete pavement. This pavement was of a different type than the ones listed above, it being a one-course instead of a two-course type. Altho the use of a reinforcement necessitated placing the pavement in two layers, both layers consisted of the same concrete mixture, this being one part of portland cement, two parts of sand and two and one-half parts of gravel. The total thickness of the pavement was 5 inches and the reinforcement was Triangle Mesh reinforcement, style 7, placed approximately in the center of the slab. The curb is 6 inches high and 5 inches thick, built directly upon the pavement and anchored to the same by means of steel loops placed every 5 feet. Expansion joints occur every 33 feet across the pavement and are protected by means of the Baker armor plate, the joints being filled with tar. The finished pavement cost $1.10 per square yard including excavation and the material and labor costs were as follows:

Cement, per barrel $1.25
Sand, per cu. yd..... 1.25
Gravel, per cu. yd..... 1.25
Common labor, per hour ..... .20

Very little excavation was required beyond surfacing to grade. The foundation consisted of a yellow clay which required the depositing of a small amount of gravel in some plaecs. The crown of the street was 4 inches for a width of pavement of 26 feet. The designing engineer was H. L. Davies, of Judson, Ind., and the contractors were Ireland Brothers, Bloomingdale, Ind.

Efficiency in Unloading Road Oils

In pace with all of the many labor, cost and time saving methods and machines in other walks of life, there has been perfected and patented an oil heater and forcer which is a necessity to anyone having road oils and tar to unload from cars or storage tanks. It will drain a car completely without a drop of waste at the rate of 100 gallons a minute, delivering the oil to sprinkler wagons at a high

temperature and requiring but one man to operate.

It spells efficiency in a score of different ways. It will pay for itself in less than one season. A sectional view illustration and circular fully describing this attachment should be in the hands of every contractor and street building official, and may be obtained by addressing the Eastern Office of MUNICIPAL ENGINEERING, 1125 World Building, New York City.

Warrenite Pavement Withstands Flood

New Haven motorists are rejoiced to find a warrenite pavement on the old macadam crossing the meadows between Middletown and Cromwell. The roadway at the point stated, has become well nigh unendurable. The new pavement has been laid upon the old macadam and the improvement is a notable one. A portion of this road was flooded at the time of the recent rise in the Connecticut river but no material damage was done to the highway by the receding waters.

Automatic Blue Printing Machinery

By Geo. J. Kirchgasser, The Cutter-Hammer Manufacturing Co., Milwaukee, Wis.

In the manufacture of motor controllers, which comprise thousands of devices from the small rheostat for simply starting an electric motor to the large automatic control panels which are used to start, accelerate, slow down and stop motors driving high speed elevators, industrial cranes and hoists, huge steel mill machinery, water works pumps, printing presses, etc., many blue prints are required. Practically all but the simplest types of these controllers must meet special requirements. The design, wiring connections, assembly or construction differ in most cases. Many drawings and blue prints are required, both for the shop in building, and for the erection men, when installing. With such a vast number of blue prints to be made, stationary sun-printing frames are out of the question and rapid machine printing, which eliminates the uncertainty of "Old Sol" is necessary.

The location of the blue print room of The Cutler-Hammer Mfg. Co. is on the same floor as the drafting room, being really a part of the latter. The clerk in charge of the tracings supervises the blue print work, which is done by one young man usually. In times of rush work one of the drafting room apprentices helps out. The windows and door of the blue print room are of colored glass.

It is a distinct advantage to have the blue print room located as it is. No time is wasted in sending tracings, a general supervision of the work can be easily exercised, and confusion and mistakes are avoided.

The machine used is known as the Pease peerless printer and during the year and one-half of use it has been very satisfactory. The accompanying illustration shows the only installation view possible as the room is not much wider than the machine and a front view only could be photographed.

The blue print paper, a yard wide and coming in rolls of 50 yards is put on a roller and passed into the machine. The tracings are fed in at the front and are carried around a glass cylinder in which five arc lamps are installed in a row. After being used for printing in this manner the tracings are returned to the tracing catcher, which is just above the feeding-in shelf. Having the tracings returned in this way instead of having them carried thru the machine, makes it possible to make many prints from the same tracings quickly, as they can be fed in as soon as they reach the tracing catcher.

The paper is passed thru a weak acid bath at the rear, from which it is run over a roller at the top. But, as it passes up, water from a perforated pipe is sprayed on it, above which is a gas heater. During the time that the paper goes up one side over the roller and down the other it is dried by the heater, after which it is passed thru a number of rolls and finally rolled up on a roller. By this time the paper is smoothed out and can be cut as desired.

The feeding mechanism is driven by a ⅛-h.p. 110-volt direct-current shunt motor located below the feed shelf. This is geared for two speeds and is also provided with a Cutler-Hammer regulator for further variation of the motor's speed. Good new tracings are fed faster than old ones as also are penciled tracings. Pencil tracings heat up quicker. Photographic negatives from which many blue prints are made are run thru at a slower rate, the ratio being about as 4½ is to 6. For removing the heat developed by the arc lamps in the glass cylinder a 12-inch fan is used, located at one end. A small 1/12-h.p. vertical motor of the same type as the other is used to drive the drying rolls.

No record has been kept of the largest output for a single day, but very frequently a great rush of work is put out in a day. The average quantity of blue print paper used per day is between three and four rolls of paper, 50 yards

per roll. This is equivalent to about 150,000 feet or about a half million tracings 9 by 12 inches. Some days the machine is in operation eight hours, while it may on other days be used only four or five hours.

Much of the work consists in making wiring diagrams and data sheets, 9 by 12 inches, small data sheets of type written copy for engineer's notebooks, 4½x 7½ inches, construction and detail diagrams, 12 by 18 inches and larger, and blue prints of photographs.

The cost of maintenance during the year and a half of installation, has been almost nothing. Of course, the carbons for the lamps are renewed and one of the snap switches has had to be repaired. The cost of operating the two small motors per month at 4 cents a kw. hr. is $1.25 and of the lamps about $16. There is no way of computing the cost of the gas used for the dryer as it is not metered separately. Machine blue-printing is the only way that the amount of blue print work turned out could be done. Little space is required, speed and reliability are attained and the cost is low.

The Johnston Sprayer

The Massachusetts State Highway Commission has been one of the foremost advocates of the surface treatment method of road construction and maintenance, and the great number of excellent roads within the state and the prominence given to Massachusetts among the states foremost in the good roads movement testifies to the soundness of its judgment in this particular line. J. A. Johnston, one of the division engineers of the Massachusetts highway commission, under whose direction a good deal of the work of saving the famous state roads of that state has been done, has produced a machine from his experience of the needs which will apply any bituminous material so as to preserve the surface of a macadam road or to build up a gravel one.

The Johnston sprayer is constructed as a separate unit mounted on two wheels, to be attached behind a tank wagon, and the whole to be drawn by a steam roller or tractor, from which steam is supplied for heating the oil or tar, and operating the sprayer. The spraying machine consists of a duplex steam pump with fittings so arranged as to give the best results with the least trouble. All parts are readily accessible and easily cleaned.

While the Johnston sprayer can be set to give any pressure desired from gravity up to 200 pounds per square inch, not less than 70 pounds is advocated, because this has been found to give excellent results after three years' trial on roads in Massachusetts, and for a longer time in Europe. The heavy pressure forces the bitumen into every crack and cranny of the road surface and by dislodging any light film of dust results in the thoro adhesion of the bitumen to the particles composing the road. The nozzles of the Johnston sprayer are so set as to drive the bitumen in a direct line to the surface, giving the greatest possible penetration.

With a Johnston sprayer the contents of a 700-gallon tank wagon can be distributed on the road in 25 minutes, and the resultant coating will be absolutely uniform if ordinary care is used. The suction connections with the tank wagon are all metal, there is no rubber hose or gasket to rot out under the action of hot bitumen.

There is a seat for the operator on the rear of the machine, with controlling valves and levers for steam and bitumen which are within easy reach of his hand. It is perfectly feasible, with the steering feature on the Johnston sprayer, to run the machine exactly on a given line. The spray nozzles on the Johnston machine are set 9 inches on centers, and the spray pipe can be extended to any length that is a multiple of 9 inches. The importance of this feature has been found to be very great, for experience shows that without this, it is difficult to so guide the tractor that the desired area is properly covered by the distributer. The control of the quantity and the place of application of any material used is at will of the operator.

The greatest economy is obtained from the machine by using the lightest form of wagon possible. Any grade of oils or tar from the lighter to the very heavy bitumens may be applied with this machine.

The sales agents for the Johnston sprayer are Wm. F. Irish (engineers), Room 42 Whitehall Building, New York City.

Chain Belt Paving Mixer

After three years of constant study and application to the street paving problem, the Chain Belt Company, of Milwaukee, Wis., have ready for distribution the Chain-Belt street paver.

This mixer is the same general design as the standard side-discharge Chain-Belt mixer.

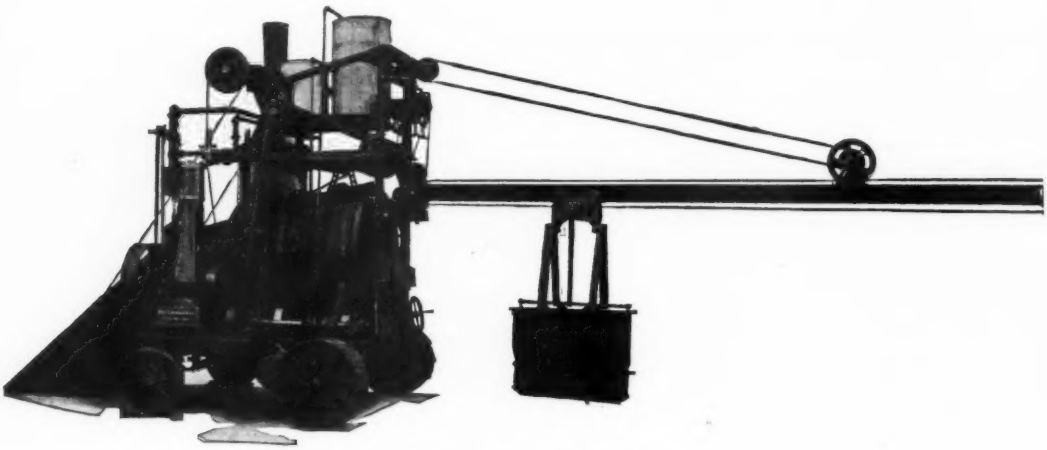
The street paver has a chain-belt drive, cast semi-steel bulge drum, chilled rollers with bronze bushings, all steel frame, etc.

This machine is especially designed for laying concrete pavements but it can be used for any class of work, and is well adapted for mixing concrete for bridge abutments, etc. It is provided with a re-

versible traction drive so that the mixer can be moved forward or backward by its own power. The traction drive is fitted with a friction clutch, and to move the machine ahead it is only necessary to throw in the clutch, and to stop the machine, throw out the clutch. The traction drive is connected to both rear wheels and is sufficiently powerful to propel the machine up an incline of 15 degrees.

The front axle is of the automobile steering knuckle-joint type, and the rear axle is a compensating differential. The latter is advantageous in that it will equalize the speed of the rear wheels in turning corners. Wheels are heavy crucible steel castings 9 inches wide.

No platforms or runways are required, and if the material is placed sufficiently close to the machine, it can be shoveled directly from the supply pile to the open end power loader bucket. All levers are so arranged that one man can operate the entire machine if necessary. The operator stands on a platform on one side of the machine, about 30 inches above the ground, and can operate the power loader, water tank, discharge and boom. The Chain-Belt paver is capable of turning out a batch of concrete in 45 seconds.



CHAIN BELT *Paving Mixer.*

Concrete Distributing Boom

The Chain-Belt street paver is equipped with a boom 20 feet long and a delivery bucket. Paving contractors have found this the most economical method of spreading concrete on the streets as it eliminates the use of wheelbarrows and carts.

The concrete is discharged from the mixer into the delivery bucket, which travels on a single boom. The boom can be swung thru an angle of 180 degrees, and a street 50 feet wide can be easily taken care of. The boom bucket will hold a full batch of mixed concrete and is provided with an automatic tripper, and the gate opens up automatically at any place where it is desired to deposit the concrete. When bucket returns to the mixer, the gate closes automatically. The same man who operates mixer levers also controls the movements of the boom and bucket.

In work where the road is less than 18 feet in width a gravity swivel chute may be substituted for the distributing boom.

The Chain-Belt street paver is made in three sizes: 10, 15, and 25 feet respectively.

The No. 12 weighs 11,000 pounds, the No. 15 weighs 14,000 pounds, and the No. 23 weighs 17,000 pounds.

Hand-Power Bar Bender

The illustration herewith shows a hand power bar bender machine for concrete reinforcement or other heavy bending. This machine is made by the Wallace Supply Company, Chicago, and can be operated by one man and will bend 1¼-inch high carbon bars, or under, cold. The ratchet lever operates the pinion against a series of teeth in the frame, at a ratio of 12 to 1. The dies are adjustable by means of set screws to suit thickness of stock to be bent.

Economical methods in construction work depend to an extensive degree upon the working devices and equipment provided engineers and contractors in the various departments of work. For example, the problem of bending cold materials readily and adaptively into every conceivable form and shape was for many

years of deep concern to building interests. Particularly has this been true since concrete construction has become one of the world's largest and most necessary industries. In the various forms and possibilities of concrete construction there exists an almost endless variety of uses to which steel bars, pipings, etc., are put and the possibility of extensive and adaptable use of these materials depends solely upon the apparatus or equipment provided for bending these materials into usable form.

During the last few years great progress has been made providing bending tools for all varieties of work, and while many of the devices were planned along intelligently considered lines, it is nevertheless true that a large number of these

BAR BENDER *made by Wallace Supply Company.*

devices were either ineffective in actual use or on the other hand were not dependable in application.

Among Wallace hand power bending tools can be found angle benders, ring benders, I benders, bar benders, pipe benders, conduit elbow former and combined iron forming, fluting and bending machine.

Value and Cost of Operating Gasoline Diaphragm Pumping Outfits

In response to inquiries from MUNICIPAL ENGINEERING several contractors and engineers have given definite information regarding the use of diaphragm pumps operated by gasoline engines for removing water from trenches and other excavations, which will be of value to others. Some of this information is given herewith.

The Phoenix Construction Co., contracting engineers, 4 Park Place, New York, write as follows:

"We have used but one type of diaphragm pumping engine. This was the Atlantic diaphragm pumping outfit, which consisted of a small gasoline engine and 3-inch diaphragm pump. The cost of operating, for gasoline and oil, was about 3 cents per hour, and required very little attention, taking altogether about two hours of a man's time during an eight-hour day. This outfit replaced two hand pumps of the same size each of which was operated by two men."

Ambursen Hydraulic Construction Company, 88 Pearl street, Boston, Mass., say:

"We use on all of our works a diaphragm pumping engine, operated by a gasoline motor. It is manufactured by Harold L. Bond Company, 391 Atlantic avenue, of this city, and is called the "Atlantic pumping engine." We have never used any other make or design and have never compared the cost of operation of these pumps with the cost of operation of any other sort of pump. For years the writer has used the Edson diaphragm pump, operated by hand on account of its convenience for small pumping operations and its convenience in transportation from place to place. These pumps will discharge quite a considerable amount of water and at times of necessity, four men have been employed on one pump. Recently the Bond Company have attached a gasoline motor to this type of pump, and have enlarged the capacity of the pump; the whole thing being light and portable. This pump, with the expenditure of a moderate amount of gasoline, will do the work of ten men. There is therefore no question of the value of such a pump as compared with a hand pump. We find it good practice, however, when larger pumping capacity is required, to install centrifugal or some other type of pump operated by steam."

Byron E. White, engineer of the Utica Gas and Electric Co., writes:

"We have had a diaphragm pumping engine, made by the Harold L. Bond Co., for about a year and a half. We have not used it very extensively, but on two short jobs that I am particularly familiar with we have found it most satisfactory. In the fall of 1911 I was engaged in digging some test pits in a gravelly formation in the bed of West Canada creek and had at times four and six men working ordinary bilge pumps and they were unable to keep the water out of the put. The pumping engine, however, was able to keep the pit drained with ease and could have handled considerable

more water, if necessary. Within the past few days we have been using it to drain a trench for a gas main under the Erie canal here in Utica, where it replaced four men using hand diaphragm pumps."

Cement Culvert Mold

The Francis Machinery Co., 5 Market street, St. Louis, Mo., makes a galvanized steel adjustable mold for making cement culverts which has some excellent features. There are several holes punched in each end of each section into which bolts can be inserted. The maximum size culvert for the sheet used is built by putting these bolts thru the outer holes, thus making the largest circle possible and lapping the sheet only a few inches. The diameter of the form can be reduced to suit the smaller diameters of culvert by drawing the sheet in and making the necessary overlap and then inserting the bolts to hold it in shape. The bolts are made easy to change by the use of thumbscrews on the inner ends. The form can be collapsed by similar movement after the concrete has set. A small block and tackle is supplied with each set of molds to aid in making the adjustments.

The 3-foot sections can be fastened together, an end of one slipping over the end of the next and the two being fastened by the same bolts, thus making the form of any desired length.

The sections are light and easily handled and transportation cost is low.

Aztec Asphalt

Aztec asphalt is distinguished as a bitumen 99.5 per cent. pure, made from Mexican asphaltic oil from the State of Vera Cruz, which is prepared for the market as a refined asphalt for paving and other purposes, an asphaltic cement with the flux added, an asphaltic road oil for use cold and also for use hot in treating road surfaces.

The analyses and tests made by the experts in bituminous paving materials show it to be practically pure bitumen and to have at the same time very high cementing value and durability and much less susceptibility to changes in temperature than the standard foreign and American asphalts.

Streets laid with the asphalt and roads treated with the road oils in several states and large cities are showing that the practical results will bear out the opinions expressed. The U. S. Asphalt Refining Co., 90 West Street, New York, has a large refinery at East Brooklyn, Baltimore, Md., to supply the market.

A New Calculating Machine

Mr. F. A. Belt, of Mt. Washington, Ohio, a district inspector under Chief Engineer Waite, of Cincinnati, has invented a new, easy and rapid method of getting cubical contents for structural concrete work, board measure for form work, circumference, areas, square root, decimal equivalents, etc; also, conversion of metric-English and English-metric. These results are accomplished by four charts wound separately on double rollers geared and operated by separate handles. By the rapid mechanism any desired column on the charts is brought to view thru the longitudinal openings on face of calculator, and the result of any multiple thereof is instantaneously shown. One chart is a multiple of whole numbers, another of fractions down to 32nds, enabling one to multiply and divide mixed numbers very rapidly. The other two charts represent cubical contents in linear feet and inches. By adjusting these charts to the required length a reading in cubical feet is had instantaneously, and correct to the thousandth part of a cubical foot. There are several ingenious combinations which greatly extend the value and convenience of the machine. Full information can be had by addressing Mr. Belt.

Selling Water at a Profit

By A. W. Seng, Supt., Municipal Water and Light Plant, Sylvan Grove, Kan.

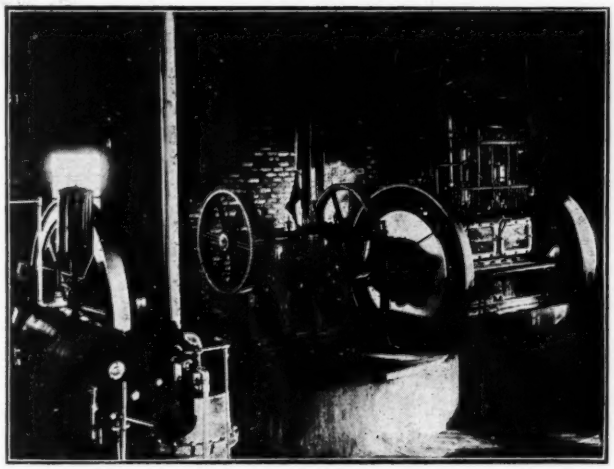
While it has been frequently proven that many water plants show big losses thru water leakage, it is my earnest belief that the great majority of those plants in the loss column are so placed on account of excessive operating costs. The cost of delivering one million gallons into the mains includes such items as fuel, handling it, salaries, oil and waste, wear and tear, labor, interest on the capital invested and other fixed charges. All this added together may total something like $40 per million gallons. But the saving of this same million gallons does not put anything like $40 into the city's pocket, since the fixed charges, etc., remain unaltered, and the labor, supervision, repairs and salaries, etc., do not come down, even if a saving of 40 or 50 per cent. is accomplished.

The oil and waste may be taken as proportional to the number of revolutions of the pumping engine, i. e., to the amount pumped. It is likewise reasonable to assume that the consumption of fuel decreases in proportion to the reduction of horse power required. This latter assumption, however, takes it for granted that the combined efficiency curve at the point corresponding to the existing con-

ditions is fairly flat, which will generally be the case.

Before installing our municipal water and light plant, we investigated very carefully operation and maintenance costs of different types of equipment, deciding in favor of that type requiring small amount of fuel as well as possessing fuel saving advantages when not in actual operation. Cost of attendance was also very carefully considered.

Our plant, which was installed during the months of November and December, 1911, at a cost of $22,699.00, by the Commercial Construction Co., Kansas City, Mo., and which has been in operation a little over sixteen months, has given very satisfactory service. This plant, which



OIL ENGINES AND PUMPS, *in the municipal water and light station at Sylvan Grove, Kan.*

we believe has made an exceptional record from an efficiency standpoint, has the following equipment:

One 50-h.p., 2-cyl., Fairbanks-Morse, internal combustion oil engine.

One 32-h.p., 1-cyl., Fairbanks-Morse, internal combustion oil engine.

One 37.5-k.v.a., 3-phase, 2,300-volt, 60-cycle alternator.

One 1.5-k.w. exciter.

One 2-panel switch-board.

Transformers, 2,200-110.

One 35-lamp, constant-current, 3.5-amp., tungsten street-lighting circuit.

One 7 by 8, triplex power pump (Smith-Vaile).

One 50,000 gallon stand-pipe.

The city sells current to its patrons at 15c per kw. hr., $1.25 minimum. Water at 25c per 1,000 gallons, $1.00 minimum.

The schedule for current is one hour before sundown till 12 o'clock at night, and 5:00 a. m. till one hour after sun-up, and Wednesday afternoons for ironing, etc., or about 10 hours per day.

The population of this town is about 600.

The city made a profit of about $200.00 during the months of December, 1912, and January, 1913, or a profit of about 50 per cent., but the average profit for the last six months was 33 per cent. However, most of this is used to pay for new connections, extensions, meters, etc., and what is left goes into a sinking fund for upkeep of the plant.

The power oil used is a 40 gravity distillate which costs us five cents per gallon tank-car lots.

The 50-h.p. engine drives the alternator by belt and is direct connected to pump by clutch, which it runs when lighting load is light. These oil engines are giving excellent service and are efficient, economical and powerful. They give every bit as good regulation as steam and are no harder to keep up. They have electrical ignition and will run on gasoline, kerosene or solar oil but have much more power with kerosene or distillate than with gasoline.

The only objection to them is that they are a trifle more noisy than a steam engine. They do away with an expensive boiler plant and its attendant evils as well as saving the cost of hiring an extra man.

This plant has been in operation for sixteen months and has lost less than one hour's time due to shut down, and has run over four months at a time without a bit of trouble or stop.

One of the noteworthy features of our plant is the fact that the pump is directly

connected to either engine by clutch. Our engine will run pump and alternator at the same time and when the pump is on there is not the slightest fluctuation in voltage. The particular advantageous feature of this type of engine is that they are exceedingly economical in operation. They can be started in less than five minutes time and need scarcely any attention when running. They require very little attention and run with perfect regulation, having a gear-driven throttling governor, butterfly type, which regulates speed within 3 per cent. from no load to full load.

This type and size of engine is well adapted for our needs, as our city is not a large one and they can be operated more economically and readily than a steam engine, especially as it is operated only about ten hours per day. It may be started or stopped at any time upon a moment's notice. A steam engine installed in our plant would have cost considerably more and would have required an extra man to operate. Both of our Fairbanks-Morse combustion oil engines use gasoline, kerosene or distillate equally well. Both of the engines have their line shafts on same center with pump between them.

Our 50-h.p. engine is used for running generator and pump while we use our 32-h.p. for pump purposes only. The source of our water supply is two wells, 30 feet apart, four feet in diameter, 35 feet deep and curbed and lined with brick; balance 12-inch iron casing. Total depth of the well is 65 feet, depth of pit 35 feet and depth of water 20 feet. We have four miles of mains.

Refuse Destructor at Halifax, N. S.

The new refuse destructor of Halifax, N. S., was tested on March 8 and accepted. The plant was constructed on specifications prepared by City Engineer F. W. W. Doane, on plans presented by the Griscom-Russell Co., of New York, the American representatives of the Hughes and Sterling Co., of London. The contract was awarded to them in competition with three companies in April, 1912.

The plant consists of one unit with three grates, top container fed type, with 200-h.p. water-tube boiler, the destructor having a capacity of 50 tons in 24 hours.

The concrete building and the run way for the collection carts to reach the storage hoppers and charging chutes and containers is shown in one of the accompanying photographs. The chimney of radial brick type is 115 feet high and 6 feet interior diameter. A rotary crusher, screen and elevator prepare the furnace clinker for city uses.

Following are official figures taken from the report of the test and show the completeness of the work done and the power obtained:

The combustion of refuse at the test was at the rate of 70 tons in 24 hours, exceeding the guaranteed capacity by 40 per cent. The calorific value of the refuse was very low, the analysis of the residues

FRONT OF GRATES *of Sterling destructor at Halifax, N. S.*

on one test showing 40 per cent. of fine dust, 37 per cent. of ash, and 23 per cent. of clinker.

Duration of test, 4 hours 8 minutes.
Number of grates, 3.
Total grate area, 75 square feet.
Boiler heating surface, 2,034 square feet.

Weights.

Total amount refuse consumed, 24,072 pounds.
Composition house ashes, 75 per cent., 18,054 pounds.
Wet garbage, 16 per cent., 3,852 pounds.
Rubbish, 9 per cent., 2,166 pounds.
Pounds burned per square foot grate per hour:
Grate No. 1, 89 pounds.
Grate No. 2, 73 pounds.
Grate No. 3, 71.5 pounds.
Average, 77.7 pounds.

Water Evaporation.

Temperature feed water, 40 degrees.
Boiler pressure (gage), 145 pounds per square inch.
Factor of evaporation, 1.227.
Total water evaporated, 29,992 pounds.
Evaporation from and at 212 degrees, 36,800 pounds.
Equivalent boiler horse power, 258.
Equivalent evaporation from and at 212 degrees per pound refuse consumed, 1.52.

Temperatures and Pressures.

Temperature combustion chamber, Fah.
Maximum, 1,547 degrees.
Minimum, 1,255 degrees.
Average, 1,357 degrees.
Percentage CO_2:
Average, 9.44.
Maximum, 12.5.
Minimum, 7.25.

Bard Avenue, West Brighton, Staten Island, N. Y. Road treated with "Tarvia B."

Of Interest to Taxpayers

A CLOUD of dust behind an automobile means that the road surface is being destroyed—blown away. It also means that the road is unfit for modern traffic—that it has been built in the old way intended for slow-moving, horse-drawn traffic.

The science of MacAdam has been rewritten these last few years. A mineral binder is no longer enough to hold the stone together.

Something stronger is needed, and the use of Tarvia is the logical and necessary answer to a difficult problem.

In the tarviated road there is a matrix of Tarvia around each stone, holding it firmly to its work and preventing it from shifting. There is no internal movement, and the attrition of traffic is reduced to a minimum.

If the road is built with Tarvia the extra cost of the treatment is more than made up in longer life and reduced maintenance cost.

There are three kinds of Tarvia—"Tarvia X" for road and pavement construction, "Tarvia A" for surface work and "Tarvia B" for dust suppression and road preservation. The first two are very dense and viscid and require heat for application. "Tarvia B" is applied cold.

Booklets on Request.

BARRETT MANUFACTURING COMPANY

TRADE B MARK

New York Chicago Philadelphia Boston St. Louis Kansas City Cleveland
Cincinnati Minneapolis Pittsburgh Seattle Corey, Ala.
The Paterson Mfg. Co., Ltd.—Montreal, Toronto, Winnipeg, Vancouver. St. John, Halifax, Sydney, N. S.

Air pressure in ash pit, 2.75 inches, water gage.

From regenerator, 3.75 inches, water gage.

Into regenerator, 4.25 inches, water gage.

Temperature outside air, 30 degrees.

Temperature air from regenerator, 180 degrees.

Temperature gases into regenerator, 475 degrees.

R. P. M. fan, 375.

Duration clinkering periods, 8 minutes.

Interval between clinkering periods, average, 92 minutes.

Labor cost per ton, city wages, 28 cents.

The Griscom-Spencer Co. have in hand a 50-ton Sterling destructor for Berkeley, Cal., and one of 40 tons to be operated in conjunction with the Columbus, O., municipal electric lighting plant.

Pullar and Enzenroth

H. B. Pullar, Assoc. Am. Soc. C. E. and C. H. Enzenroth, B. S., announce the opening of their consulting laboratory at 378 Woodward Ave., Detroit, Mich.

Mr. Pullar was formerly assistant manager and chief chemist of The American Asphaltum & Rubber Co., Chicago, also chief chemist for J. F. Hill, paving contractor, and has for the past six years been in close touch with the rapid development of the paving and road industry; he has also had long experience in the testing of asphalts and bitumens, and the practical handling of these materials in the construction of roads and pavements, having made and supervised the mixes on approximately 10,000,000 square yards of bituminous roads and pavements of various types.

Mr. Enzenroth is a graduate chemical engineer of the University of Michigan and has for the past few years been associated with Mr. Pullar. He has had wide experience in the testing of different kinds of asphalts, bitumens, paints, oil, etc.

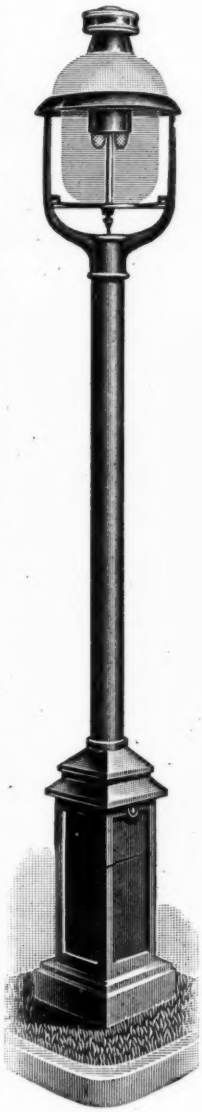
They will conduct a general testing laboratory, but will make a specialty of road and pavement inspection and the testing of bituminous materials. They have a plan for the inspection of pavements which they claim is new, practical and thoro, and will be of equal interest to engineers, city officials, contractors, and producers. They will give special attention to municipal plant work.

Garbage Destructor for Los Angeles

Los Angeles, Cal., will open bids on June 20 for a garbage and refuse destructor plant of 450 tons capacity.

A New Type of Street Lamp

The accompanying illustration shows a gasoline street and park lamp that is now installed in the city of Des Moines, Iowa, which city has purchased 400 of the Coleman boulevard lamps for use in their parks and outlying residence sections. They decided upon this type of park lighting because of the quantity and quality of the lights and the low cost to install and operate them.



They have been using a gasoline blinker light of about 80 to 100 candle power, but discarded them for the Coleman lamp, which when equipped with their smallest mantle produces between 250 and 300 candle power, altho where a brighter light is wanted they will use a larger mantle and more gas, obtaining in this way a light equal to the average electric arc.

The Des Moines lamps are to be taken care of by their park watchman, which adds no expense for this purpose. The quantity of gasoline used per night for midnight service is estimated to cost about two cents per lamp, with total cost for upkeep well under $10.00 per lamp per year.

The lamps are made with cast iron post, other parts of copper and brass. A gasoline tank is contained in the base of the post. Into it each day is put just enough gasoline or oil to burn the desired number of hours. By air pressure the gasoline feeds up a small copper tube to the generator between the mantles, where it is turned into vapor, which, mixed with air, forms a gas that is burned like natural or other artificial gas.

The Coleman boulevard lamp is manufactured by The Coleman Lamp Company, of Toledo, Ohio, and Wichita, Kansas. They desire correspondence with cities and villages needing anything in street lighting.

Sewer Contractors—LISTEN!

AT LAST—a Centering has been Perfected and it is of 100% efficiency.

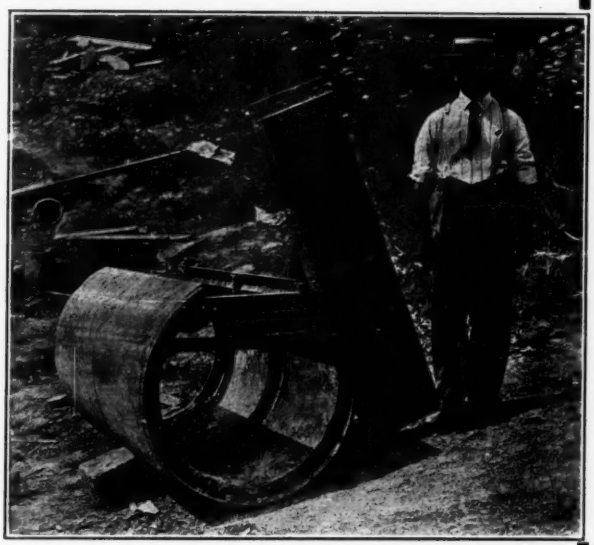
Now you can cut your costs. Now you can increase your profits. Now you can out-bid all of them, every time, and land the contract by using

The O'Connor Collapsible Steel Centering

FOR CONCRETE SEWERS AND CONDUITS.

(Patented)

The diameter can never vary.



This shows the removable section.

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How to Obtain Best Results from Wood Block Pavements

By H. L. Collier, C. E., St. Louis, Mo.

If the wood blocks are treated with 20 pounds to the cubic foot with creosote oil, the specific gravity of which is around 1.14, during the first hot season after construction the blocks will bleed. The 20 pounds per cubic foot about fills the pores of the blocks and a change of temperature from 60 degrees Fahr. to 120 degrees Fahr. will cause the heavy oil to expand 10 per cent., and following the course of least resistance it will exude on the surface of the blocks. This oozing does not in the least injure the blocks, but on the contrary is a benefit to the pavement in that it fills all cracks, and makes of the filler between the blocks a waterproof mastic. The bleeding is a positive proof that the oil called for by the city engineer's specifications and certified to by the inspector at the creosote plant was forced into the blocks.

The objectionable feature of the bleeding is its stickiness, being easily tracked on to the walks and into adjacent buildings, all of which can be avoided by an occasional sprinkling of pebbly sand on the surface of the pavement during the first hot season. (It is well to remember that gasoline will remove the exuding oil from walks, floors or rugs easier than water will remove mud.

The bleeding can be avoided by the use of a lighter oil, from 1.06 to 1.10 specific gravity, and the treatment not to exceed 18 pounds per cubic foot under a pressure of from 100 to 150 pounds per square inch applied *slowly*.

The buckling of wood blocks is the least expensive, the least harmful and the easiest remedied of anything that can happen to any pavement.

In a buckle no block is injured and any laborer with ordinary intelligence with a hatchet can replace the blocks and make the pavement look as well as when first laid. The foundation is in no wise affected by a buckle. The blocks are easily removed and relaid, the last two or three being trimmed slightly so as to fit snugly, not too tight, and sand thrown over the repaired area or an asphalt cement filler used.

A buckle does not necessarily belong to the pavement; is as easily avoided, and not nearly so expensive or troublesome as blow-ups in brick or waves on asphalt or bitulithic paving. It is necessary to provide proper expansion joints.

The most fruitful sources of buckles on a wood block pavement are transverse expansion joints. They are not safety valves to prevent, but rather direct causes of buckles. The evil effect is apparent on all pavements where used in every city, and why they are still used I cannot understand.

Mr. G. W. Tillson, former chief engineer of New York, now consulting engineer of Brooklyn, has has wood block pavement closely laid both transversely and longitudinally, with no expansion joints and he told the writer in February, 1913, that he has had no buckles either in New York or Brooklyn.

My preference is to lay the blocks with close joints sidewise, with ⅛-inch joint between the ends of the blocks, and ample expansion joints at the curbs with an asphalt cement filler or specially prepared paving pitch which will not melt under the summer's heat or become brittle from the winter's cold.

Creosoted wood block paving is slippery if not clean, when slightly damp from heavy dew, light frost or snow, but not more slippery than asphalt, bitulithic, or brick with cement filler under the same climatic conditions.

To a large extent the slipperiness can be overcome by laying the pavement as nearly flat transversely as the longitudinal grade will admit, not more than ¼-inch to the foot from center to curb, better less.

Between street car rails, and between the tracks where doubled, the pavement should be laid flat transversely and on a level with the top of the rails.

Recently in Newark, N. J., the question of repaving Broad street was under discussion before the Broad Street Merchants' Association and the question of slipperiness was carefully considered.

There is in the city a drive known as "Plank Road" where a part is paved with granite block and a part with wood. An account of observations made during the week ending January 18, 1913, showed that of the vehicles of all kinds passing over the road, 72.2 per cent. used the wood block pavement, and only 27.8 per cent., the granite pavement; of the total rubber tired traffic, practically all of the motor truck variety, 89.3 per cent. used the wood blocks, while only 10.7 per cent. used the granite blocks. (Wood block paving was selected by Newark for Broad street repavement.)

As to the last complaint, that the pavement is easy to slight in construction, no pavement is so easily constructed and in no part of the construction can even a novice be deceived, except in the quality of the oil, which is always tested by an expert employed by the city. As to the penetration of the blocks, values are not destroyed if a thousand blocks are halved with a sharp hatchet, which will so disclose the degree of the penetration and the soundness of the timber as to enable any one to determine whether or not the specifications have been carried

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out. Every engineer reserves the right to make these physical tests after the blocks have been delivered on the street to be paved.

The concrete foundation is the same under all pavements and because of the ease with which wood blocks are trimmed to fit they are very much more easily laid than brick or granite blocks.

Trade Notes

C. Wadsworth has established an office at 961-3 Woodward Ave., Detroit, Mich., to represent manufacturers of contractors' machinery and materials, especially municipal contractors.

The Architects Samples Co., Inc., has opened offices in the Architects building, Park Ave. and 40th St., New York, to provide for display of requested samples, delivery of same to architects' offices, to obtain information regarding materials, to prepare and issue bulletins and to keep catalogs for reference and distribution.

John Wiley & Sons, Inc., the well-known technical-book publishers, have removed their business to 432 Fourth Ave., corner of 29th street, New York City.

The Raymond Concrete Pile Co., has been awarded contracts for placing piles for the foundations of the new boiler house and laundry building on Randall's Island, New York; a new warehouse for S. J. Van Lill Co., Baltimore, Md.; and a crane runway for the Crucible Steel Co. of America, at its LaBelle works.

Metcalf and Eddy, civil engineers, Boston, Mass., have admitted to partnership several of their employes, including Charles W. Sherman, principal assistant, William T. Barnes, in charge of Chicago office, and Almon L. Fales.

Citizens of New Carlisle, Ind., have just voted unanimously for the construction of 12 miles of concrete highway. The Universal Portland Cement Co., is to write the specifications and the roadway will be 9 feet wide with 3-foot gravel shoulders. This work came as the result of an inspection of the concrete roads at Buchanan, Mich.

Bids were opened recently for 30,000 yards of concrete pavement to be placed at South Bend, Ind. This is the first installment on more extensive work of the same kind contemplated for the summer.

The city of Des Moines, Iowa, thru its "Greater Des Moines Committee," issues some of the most satisfactory city advertising literature which is received at this office, because it is reasonable and accurate and does not claim everything in and out of sight.

D. B. Luten is distributing the final decree, the eighteenth he has received on his patents, adjudging valid the twelve patents included in the suit, requiring Gaffey and Byrnes, the defendants to pay him royalty of 10 per cent. on the contract price of the infringing structure, and enjoining them from building other infringing structures.

The sole agency for the Johnston sprayer, and Kent's oil heater and forcer has been secured by Wm. F. Irish, engineers. With the good combination of an aggressive, capable manager in Mr. Irish, a large and efficient sales force and two fully proven speccialties of such merit and value as these, busy times are assured in the handsomely furnished "Irish Headquarters," away up on the 28th floor of the Whitehall Building (Room 2842), New York.

Trade Publications

The Kewanee Boiler Co., Kewanee, Ill., publishes "Evidence" of the efficiency and economy of Kewanee smokeless fire box boilers.

Bulletin No. 10 on the Illmer gas engine has been issued by the Reading Iron Co., Reading, Pa.

We are in receipt of advance sheets of the new illustrated catalog of the Heer Engine Co., Portsmouth, O., which fully describes their traction engine as applied to road making, including scraping, grading, rooting, placing, hauling and running other machinery, such as crushers, mixers, etc.

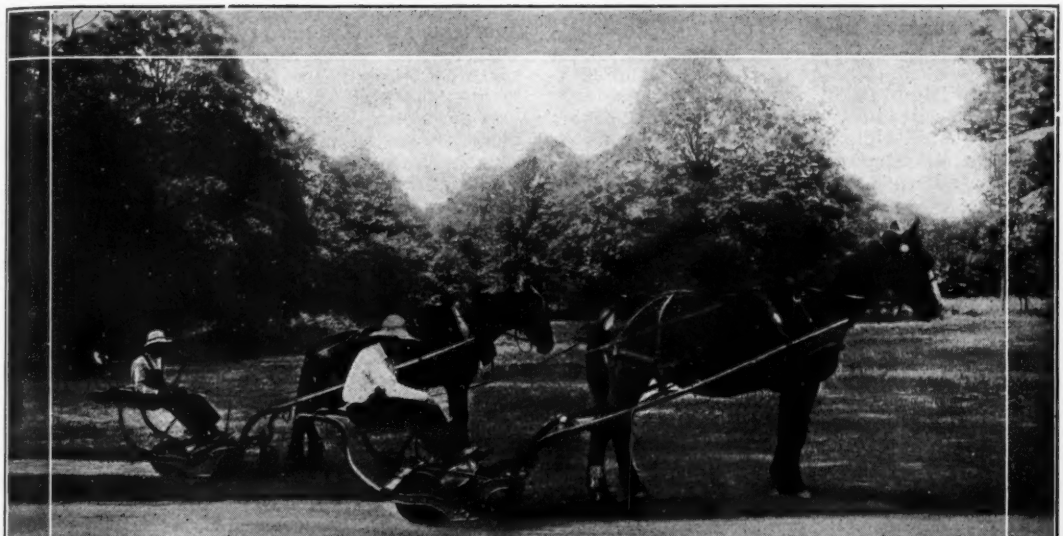
Keuffel & Esser Co. issue a descriptive price list of planimeters and their appurtenances from Hoboken, N. J.

Bulletin No. 34-L, of the Chicago Pneumatic Tool Company's Compressor Department treats particularly of general engineering information of value to users of compressed air. It contains tables giving efficiencies of air compression at different altitudes, density of gases and vapors, mean effective pressures and horse powers, loss of pressure due to friction in pipes, and many others, some rare and all important; also information for intending purchasers, showing the data required for intelligent estimates. Views of various types of compressors are shown in miniature, as well as illustrations showing the interior of the Pneumatic Tool Company's Compressor Plant at Franklin, Pa. It will be sent upon application to the company, Fisher Building, Chicago, or No. 50 Church St., New York City, or any of its branches in all large cities.

The Koehring Machine Co., Milwaukee, Wis., issue a monthly publication entitled "The Mixer."

The Chain Belt Co., Milwaukee, Wis., issue their "Chain Belt" monthly, the April number showing their new foundry.

"The Jewell Bulletin" gives monthly news of the stock and business of the



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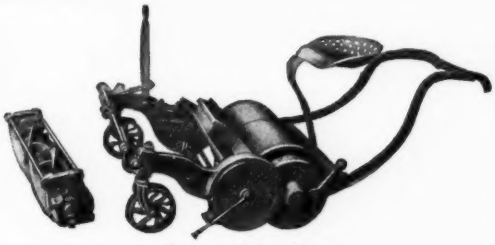
If one cutter needs sharpening or repair, it takes less than a minute to remove it from the frame and attach another.

No waste of time sending the whole mower to the shop. No heavy freight charges.

Send for leaflet giving full description and prices, together with practical booklet on The Care of Lawns.

The Coldwell Company makes lawn mowers in 150 different styles and sizes. The Coldwell Combination Roller and Motor Lawn Mower is the best and most economical mower ever made for use on large stretches of lawn.



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Philadelphia NEWBURGH, NEW YORK Chicago

Jewell Nursery Co., Lake City, Minn.

"The J-M Power Expert" of the H. W. Johns-Manville Co., for May shows the new turbine plant of the Cleveland Electric Illuminating Co.

The Producers' Gas Engine is a product of the Producers' Supply Co., Franklin, Pa., described in a recent circular.

Catalog 33 of The C. D. Bartlett & Sons Co., Cleveland, O., shows the various styles of their Universal crane and excavator.

"Channon's Review" is a medium of communication to H. Channon Co., Chicago, Ill., with their customers.

Weber coniform reinforced concrete chimneys and their construction are quite fully described in a booklet on "Weber Chimneys" published by the Weber Chimney Co., Chicago, Ill.

The saving from using a Kewanee water heating garbage burner is set forth in a pamphlet issued by the Kewanee Boiler Co., Kewanee, Ill.

The General Fireproofing Co., Youngstown, O., issue a circular on their Allsteel filing drawers, cases, cabinets and safes.

Daniel B. Luten, designing and consulting engineer, Indianapolis, Ind., was very commendably prompt in issuing a booklet on "Reinforced Concrete Bridges in the Easter Flood," which shows the differences in stability between bridges of Luten design and many others.

Bulletin No. 3 of the Hoskins Mfg. Co., 453 Lawton Ave., Detroit, describes the Hoskins thermo-electric pyrometers.

The Turbine Sewer Machine Renovating Co., 197 11th St., Milwaukee, Wis., issue a fully illustrated booklet showing the work which has been done by their turbine sewer cleaning machine in removing serious stoppages from sewers.

Joseph A. Anglada, M. E., 1790 Broadway, N. Y., has issued a pamphlet on denatured alcohol as a decarbonizer and engine cleanser.

Samuel Cabot, Inc., Boston, Mass., publish a handsome reproduction of a photograph of the first suspension bridge in America and a pamphlet describing "Conservo" wood preservative used on the wood employed in restoring the bridge recently.

Spray Engineering Co., Boston, Mass., publish a fully illustrated bulletin, No. 51, descriptive of their air washers, laying stress on the nozzle.

The Griscom-Russell Co. have published special bulletin 704 giving report of official tests of a Sterling refuse destructor installed at Halifax, N. S.

The Crosby Steam Gage and Valve Co., Boston, Mass., issue a valuable cloth bound book of 201 pages entitled "Practical Instructions relating to the construction and use of the steam engine indicator."

We are indebted to Wm. F. Irish, 2842 Whitehall Building, New York, for a 56-page fully illustrated book, "The Construction and Maintenance of Roads." While this book modestly advocates the use of certain road and street making machines, it is notably of value for the exhaustive and authoritative manner in which it presents and solves many road making problems. The author, J. A. Johnston, is well known for his successful record as engineer on the Massachusetts State Highway Commission.

Publications Received

Report of State Roads Commission of Maryland for 1908 to 1911, inclusive. W. W. Crosby, Chief Engineer, Baltimore, Md.

Sixteenth biennial report of the State Engineer of Colorado for 1911-12. Charles W. Comstock, State Engineer.

Memoir by the Prefect of the Seine to the municipal council, and reports upon the annexation of the military zone to the city of Paris and transfer of the fortifications to the city for public and ornamental purposes, with memoranda of agreements between the city and the French government rendering the project possible. Marcel Delanney, Prefect of the Seine, acting for the city of Paris, and Alexander Millerand, minister of war and M. Klotz, minister of finance, acting for the state.

Eighteenth annual report of the Board of Public Works, Little Falls, N. Y., for 1912. Frank H. Shall, Mayor; O. J. Dempster, City Engineer.

Report on the Improvement and Development of the Transportation Facilities of San Francisco. Cloth, 469 pp. with many illustrations. Charts, tables, etc. $1. By Bion J. Arnold, consulting engineer, Chicago, Ill.

A Study of the Organization and Procedure of Each Permanent Board, Commission, Committee and Office, except those concerned with courts, education and elections, in the city of Bridgeport, Conn., by Peter White, C. P. A.

Twentieth Annual Report of the Board of Electrical Commissioners of South Norwalk, Conn., 1912. A. E. Winchester, Gen. Supt.

Asphalt Construction for Pavements and Highways. A pocket book for engineers, contractors and inspectors, by Clifford Richardson, consulting engineer, M. Am. Soc. C. E., F. C. S. Leather, 155 pp. $2, net. McGraw-Hill Book Co., 239 W. 39th St., New York.

Specifications for Street Roadway Pavements, with instructions to inspectors on street paving work, by S. Whinery, M. Am. Soc. C. E. Cloth, 116 pp. $1, net. McGraw-Hill Book Co., 239 W. 39th St., New York.

Third biennial report of the Department of Engineering of California, 1911-

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Slow Speed Motor.
No Springs.
No Vibration.
Highest Efficiency.

1,000 gallons per minute at 120 lbs. pressure
600 gallons per minute at 200 lbs. pressure

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12. W. F. McClure, State Engineer; Austin B. Fletcher, State Highway Engineer.

Fourth Annual report of the Department of Water, San Diego, Cal. Hubert R. Fay, councilman, superintendent; H. A. Whitney, asst. supt. and engineer.

Special Report of the Comptroller of the city of St. Louis, transmitting report of the bureau for revision of accounts and methods. B. J. Taussig, Comptroller.

American Civil Engineers' Pocket Book. Editor in Chief, Mansfield Merriman. Associate Editors: I. O. Baker, A. H. Blanchard, C. B. Breed, W. J. Douglas, L. A. Fischer, G. A. Goodenough, A. Hazen, F. P. McKibben, E. R. Maurer, R. P. Miller, A. Noble, F. E. Turneaure, W. L. Webb, G. S. Williams. Leather, 1473 pp. $5.

Annual report Division of Sewage Disposal, Columbus, O. C. B. Hoover, chemist in charge of sewage purification works.

Practical Methods of Sewage Disposal for residences, hotels and institutions. By Henry N. Ogden, M. Am. Soc. C. E., professor of sanitary engineering, Cornell Univ., and H. Burdett Cleveland, Assoc. M. Am. Soc. C. E., principal assistant engineer, N. Y. State Department of Health. Cloth, 132 pp. John Wiley & Sons, New York.

Highway Engineering as presented at the second international road congress, Brussels, 1910. By Arthur H. Blanchard, C. E., A. M., professor of highway engineering, Columbia Univ., consulting highway engineer, M. Am. Soc. C. E., etc., and Henry B. Drowne, C. E., instructor and assistant, Assoc. M. Am. Soc. C. E., etc. Cloth, 299 pp. $2, net. John Wiley & Sons, New York.

Street Pavements and Paving Materials; a manual of city pavements, the methods and materials of their construction, for the use of students, engineers, and city officials. By Geo. W. Tillson, C. E., consulting engineer to the borough president of Brooklyn, M. Am. Soc. C. E., Am. Soc. Mun. Imp., etc. Cloth, 651 pp., $4, net. John Wiley & Sons, New York.

Building Stones and Clay Products; a handbook for architects. By Heinrich Ries, Ph. D., professor of Economic geology in Cornell Univ., F. G. S. A., M. A. I. M. E., etc. Cloth, 415 pp., $3, net. John Wiley & Sons, New York.

Concrete Costs; tables and recommendations for estimating the time and cost of labor operations in concrete construction and for introducing economical methods of management. By Frederick W. Taylor, M. E., Sc. D., and Sanford E. Thompson, S. B., M. Am. Soc. C. E., consulting engineer; authors of A Treatise on Concrete, Plain and Reinforced. Cloth, 709 pp. John Wiley & Sons, New York.

Shade Trees in Towns and Cities; their selection, planting, and care as applied to the art of street decoration; their diseases and remedies; their municipal control and supervision. By William Solotaroff, B. S., secretary and superintendent of the shade-tree commission of East Orange, N. J. Cloth, 287 pp., $3, net. John Wiley & Sons, New York.

A Textbook on Roads and Pavements. By Frederick P. Spalding, professor of civil engineering, Univ. of Missouri, M. Am. Soc. C. E. Cloth, 408 pp., $2, net. John Wiley & Sons, New York.

The Subways and Tunnels of New York; methods and costs; with an appendix on tunneling machinery and methods, and tables of engineering data. By Gilbert H. Gilbert, Lucius L. Wightman and W. L. Saunders. Cloth, 372 pp., $4, net. John Wiley & Sons, New York.

Report of Chemical and Biological Survey of the Waters of Illinois for 1911. Edward Bartow, Urbana, director. Paper, 173 pp.

Annual report of the water works of Milwaukee, Wis., for 1912. H. P. Bohmann, supt.

Forty-seventh annual report of the water commissioners of Newburg, N. Y., for 1912. Curtis Stanton, supt.

Principles and Practice of Surveying. By Breed and Hosmer of the Massachusetts Institute of Technology. Vol. I, elementary, $3; Vol. II, higher, $2.50.

Lefax, Vol. 3, No. 3. Subscriptions on basis of $2 for 200 sheets. Standard Cooperation, Penna Bldg., Philadelphia, Pa.

Nineteenth annual report of Water Board of Auburn, N. Y. J. Walter Ackerman, Chief Engineer and Superintendent.

Public Road Systems of Foreign Countries and of the Several States. Prepared under the direction of Hon. Jonathan Bourne, Jr., chairman of the joint committee on Federal Aid in the construction of public roads for the use of the Committee, April 24, 1913. Government Printing Office, Washington, D. C.

Forms for Special Assessments, Illinois. Prepared and compiled by A. H. Baer, Belleville, Ill., for the use and guidance of municipal engineers of the state of Illinois. Published by the National Paving Brick Manufacturers' Association, B. of L. E. bldg., Cleveland, O.

Plane Surveying by J. C. Tracy, C. E., of the Department of Civil Engineering, Sheffield, Scientific School of Yale University. Leather pocketbook, nearly 800 pp., $3. John Wiley & Sons, New York.

Wisconsin Railroad Commission Reports, Vol. 7, June-Sept., 1911, 863 pp.; Vol. 8, Sept., 1911-Mar. 1912, 887 pp. John Roemer, chairman, Madison, Wis.

Fourth report of the Illinois Highway Commission, for 1910, 1911, 1912. A. N. Johnson, state engineer, Springfield, Ill. Paper, 345 pp.